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**Department of Defense  
Fiscal Year (FY) 2013 President's Budget Submission**

February 2012



**Air Force**

*Justification Book Volume 1*

***Research, Development, Test & Evaluation, Air Force***

**Volume I**

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Air Force • President's Budget Submission FY 2013 • RDT&E Program

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**February 2012**

**INTRODUCTION AND EXPLANATION OF CONTENTS**

1. (U) GENERAL

A. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY 2013 Program/Budget Review Submission.

- 1) All exhibits in this document have been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, Section 050402. Exception:
  - a) Exhibit R-1, RDT&E Program, which was distributed under a separate cover due to classification.
- 2) Other comments on exhibit contents in this document:
  - a) Exhibits R-2/2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2013 RDT&E program with the exception of classified program elements. The format and contents of this document are in accordance to the guidelines and requirements of the Congressional committees in so far as possible.
  - b) The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.

2. (U) CLASSIFICATION

A. All exhibits contained in Volumes I, II, and III are unclassified. Classified exhibits are not included in the submission due to the level of security classification and necessity of special security clearances.

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Department of the Air Force  
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 Total Obligational Authority  
 (Dollars in Thousands)

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Summary Recap of Budget Activities -----	FY 2011 Actuals	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Basic Research	476,425	530,859		530,859
Applied Research	1,176,015	1,219,086		1,219,086
Advanced Technology Development	502,853	627,102	58,600	685,702
Advanced Component Development & Prototypes	1,568,398	1,444,578		1,444,578
System Development & Demonstration	3,185,265	3,850,525		3,850,525
RDT&E Management Support	1,396,405	1,350,461		1,350,461
Operational Systems Development	19,115,999	17,457,590	201,000	17,658,590
Total Research, Development, Test & Evaluation	27,421,360	26,480,201	259,600	26,739,801
 Summary Recap of FYDP Programs -----				
Strategic Forces	466,679	533,079		533,079
General Purpose Forces	2,189,250	1,967,367	50,000	2,017,367
Intelligence and Communications	2,580,248	2,209,300	82,000	2,291,300
Mobility Forces	425,404	285,289		285,289
Research and Development	8,423,493	9,259,688	58,600	9,318,288
Central Supply and Maintenance	283,788	225,312		225,312
Training Medical and Other	7,330	1,956		1,956
Administration and Associated Activities	74,361	94,584		94,584
Support of Other Nations	3,636	3,798		3,798
Classified Programs	12,967,171	11,899,828	69,000	11,968,828
Total Research, Development, Test & Evaluation	27,421,360	26,480,201	259,600	26,739,801

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Summary Recap of Budget Activities -----	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Basic Research	516,034		516,034
Applied Research	1,109,053		1,109,053
Advanced Technology Development	596,737		596,737
Advanced Component Development & Prototypes	1,181,177		1,181,177
System Development & Demonstration	4,966,724		4,966,724
RDT&E Management Support	1,190,349		1,190,349
Operational Systems Development	15,867,972	53,150	15,921,122
Total Research, Development, Test & Evaluation	25,428,046	53,150	25,481,196
Summary Recap of FYDP Programs -----			
Strategic Forces	222,582		222,582
General Purpose Forces	1,820,202		1,820,202
Intelligence and Communications	1,916,639		1,916,639
Mobility Forces	244,314		244,314
Research and Development	9,750,681		9,750,681
Central Supply and Maintenance	179,795		179,795
Training Medical and Other	1,760		1,760
Administration and Associated Activities	116,039		116,039
Support of Other Nations	3,851		3,851
Classified Programs	11,172,183	53,150	11,225,333
Total Research, Development, Test & Evaluation	25,428,046	53,150	25,481,196

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Appropriation: 3600F Research, Development, Test &amp; Eval, AF

Line No	Program Element Number	Item	Act	FY 2011 Actuals	FY 2012 Base	FY 2012 OCO	FY 2012 Total	S e c
---	-----	----	---	-----	-----	-----	-----	-
1	0601102F	Defense Research Sciences	01	336,021	364,328		364,328	U
2	0601103F	University Research Initiatives	01	127,656	152,273		152,273	U
3	0601108F	High Energy Laser Research Initiatives	01	12,748	14,258		14,258	U
		Basic Research		476,425	530,859		530,859	
4	0602102F	Materials	02	136,846	144,219		144,219	U
5	0602201F	Aerospace Vehicle Technologies	02	140,261	147,628		147,628	U
6	0602202F	Human Effectiveness Applied Research	02	89,862	86,663		86,663	U
7	0602203F	Aerospace Propulsion	02	198,878	207,406		207,406	U
8	0602204F	Aerospace Sensors	02	158,516	134,632		134,632	U
9	0602601F	Space Technology	02	114,718	115,158		115,158	U
10	0602602F	Conventional Munitions	02	60,365	60,656		60,656	U
11	0602605F	Directed Energy Technology	02	110,323	141,078		141,078	U
12	0602788F	Dominant Information Sciences and Methods	02	114,732	127,855		127,855	U
13	0602890F	High Energy Laser Research	02	51,514	53,791		53,791	U
		Applied Research		1,176,015	1,219,086		1,219,086	
14	0603112F	Advanced Materials for Weapon Systems	03	39,638	60,719		60,719	U
15	0603199F	Sustainment Science and Technology (S&T)	03	2,764	5,780		5,780	U
16	0603203F	Advanced Aerospace Sensors	03	42,105	63,066	58,600	121,666	U
17	0603211F	Aerospace Technology Dev/Demo	03	49,428	67,474		67,474	U
18	0603216F	Aerospace Propulsion and Power Technology	03	129,925	120,924		120,924	U
19	0603270F	Electronic Combat Technology	03	16,029	22,231		22,231	U

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1	0601102F	Defense Research Sciences	01	361,787		361,787	U
2	0601103F	University Research Initiatives	01	141,153		141,153	U
3	0601108F	High Energy Laser Research Initiatives	01	13,094		13,094	U
		Basic Research		516,034		516,034	
4	0602102F	Materials	02	114,166		114,166	U
5	0602201F	Aerospace Vehicle Technologies	02	120,719		120,719	U
6	0602202F	Human Effectiveness Applied Research	02	89,319		89,319	U
7	0602203F	Aerospace Propulsion	02	232,547		232,547	U
8	0602204F	Aerospace Sensors	02	127,637		127,637	U
9	0602601F	Space Technology	02	98,375		98,375	U
10	0602602F	Conventional Munitions	02	77,175		77,175	U
11	0602605F	Directed Energy Technology	02	106,196		106,196	U
12	0602788F	Dominant Information Sciences and Methods	02	104,362		104,362	U
13	0602890F	High Energy Laser Research	02	38,557		38,557	U
		Applied Research		1,109,053		1,109,053	
14	0603112F	Advanced Materials for Weapon Systems	03	47,890		47,890	U
15	0603199F	Sustainment Science and Technology (S&T)	03	6,565		6,565	U
16	0603203F	Advanced Aerospace Sensors	03	37,657		37,657	U
17	0603211F	Aerospace Technology Dev/Demo	03	81,376		81,376	U
18	0603216F	Aerospace Propulsion and Power Technology	03	151,152		151,152	U
19	0603270F	Electronic Combat Technology	03	32,941		32,941	U

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20	0603401F	Advanced Spacecraft Technology	03	75,103	74,009		74,009	U
21	0603444F	Maui Space Surveillance System (MSSS)	03	14,802	13,555		13,555	U
22	0603456F	Human Effectiveness Advanced Technology Development	03	23,445	25,283		25,283	U
23	0603601F	Conventional Weapons Technology	03	14,764	45,542		45,542	U
24	0603605F	Advanced Weapons Technology	03	16,104	48,666		48,666	U
25	0603680F	Manufacturing Technology Program	03	46,564	40,103		40,103	U
26	0603788F	Battlespace Knowledge Development and Demonstration	03	30,403	38,628		38,628	U
27	0603924F	High Energy Laser Advanced Technology Program	03	1,779	1,122		1,122	U
		Advanced Technology Development		502,853	627,102	58,600	685,702	
28	0603260F	Intelligence Advanced Development	04	4,993	4,013		4,013	U
29	0603287F	Physical Security Equipment	04	967	3,586		3,586	U
30	0603430F	Advanced EHF MILSATCOM (SPACE)	04	385,033	397,446		397,446	U
31	0603432F	Polar MILSATCOM (SPACE)	04	138,051	101,348		101,348	U
32	0603438F	Space Control Technology	04	63,310	44,635		44,635	U
33	0603742F	Combat Identification Technology	04	35,208	38,447		38,447	U
34	0603790F	NATO Research and Development	04	4,265	4,424		4,424	U
35	0603791F	International Space Cooperative R&D	04	581	615		615	U
36	0603830F	Space Protection Program (SPP)	04	8,306	7,299		7,299	U
37	0603850F	Integrated Broadcast Service - Dem/Val	04	20,396	20,046		20,046	U
38	0603851F	Intercontinental Ballistic Missile - Dem/Val	04	67,242	69,436		69,436	U
39	0603854F	Wideband Global SATCOM RDT&E (Space)	04	74,857	12,692		12,692	U

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20	0603401F	Advanced Spacecraft Technology	03	64,557		64,557	U
21	0603444F	Maui Space Surveillance System (MSSS)	03	29,256		29,256	U
22	0603456F	Human Effectiveness Advanced Technology Development	03	21,523		21,523	U
23	0603601F	Conventional Weapons Technology	03	36,352		36,352	U
24	0603605F	Advanced Weapons Technology	03	19,004		19,004	U
25	0603680F	Manufacturing Technology Program	03	37,045		37,045	U
26	0603788F	Battlespace Knowledge Development and Demonstration	03	31,419		31,419	U
27	0603924F	High Energy Laser Advanced Technology Program	03				U
		Advanced Technology Development		596,737		596,737	
28	0603260F	Intelligence Advanced Development	04	3,866		3,866	U
29	0603287F	Physical Security Equipment	04	3,704		3,704	U
30	0603430F	Advanced EHF MILSATCOM (SPACE)	04	229,171		229,171	U
31	0603432F	Polar MILSATCOM (SPACE)	04	120,676		120,676	U
32	0603438F	Space Control Technology	04	25,144		25,144	U
33	0603742F	Combat Identification Technology	04	32,243		32,243	U
34	0603790F	NATO Research and Development	04	4,507		4,507	U
35	0603791F	International Space Cooperative R&D	04	652		652	U
36	0603830F	Space Protection Program (SPP)	04	10,429		10,429	U
37	0603850F	Integrated Broadcast Service - Dem/Val	04	19,938		19,938	U
38	0603851F	Intercontinental Ballistic Missile - Dem/Val	04	71,181		71,181	U
39	0603854F	Wideband Global SATCOM RDT&E (Space)	04	12,027		12,027	U

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Line No	Program Element Number	Item	Act	FY 2011 Actuals	FY 2012 Base	FY 2012 OCO	FY 2012 Total	Sec
40	0603859F	Pollution Prevention - Dem/Val	04	2,447	2,075		2,075	U
41	0603860F	Joint Precision Approach and Landing Systems - Dem/Val	04	12,452	19,879		19,879	U
42	0604015F	Long Range Strike	04	192,816	294,911		294,911	U
43	0604283F	Battle Mgmt Com & Ctrl Sensor Development	04	12,994	30,362		30,362	U
44	0604317F	Technology Transfer	04		2,553		2,553	U
45	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	22,275	33,248		33,248	U
46	0604330F	Joint Dual Role Air Dominance Missile	04	9,465	29,759		29,759	U
47	0604337F	Requirements Analysis and Maturation	04	32,797	23,511		23,511	U
48	0604422F	Weather Satellite Follow-on	04		123,681		123,681	U
49	0604436F	Next-Generation MILSATCOM Technology Development	04	19,898				U
50	0604635F	Ground Attack Weapons Fuze Development	04	22,398	24,467		24,467	U
51	0604775F	Defense Rapid Innovation Program	04	104,464				U
52	0604796F	Alternative Fuels	04	23,259				U
53	0604830F	Automated Air-to-Air Refueling	04	83				U
54	0604857F	Operationally Responsive Space	04	124,983	110,379		110,379	U
55	0604858F	Tech Transition Program	04	11,842	2,766		2,766	U
56	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	04					U
57	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	173,016	43,000		43,000	U
	Advanced Component Development & Prototypes			1,568,398	1,444,578		1,444,578	
58	0603840F	Global Broadcast Service (GBS)	05	25,793	5,631		5,631	U
59	0604222F	Nuclear Weapons Support	05	59,591	18,475		18,475	U

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Line No	Program Element Number	Item	Act	FY 2013 Base	FY 2013 OCO	FY 2013 Total	Se
40	0603859F	Pollution Prevention - Dem/Val	04	2,054		2,054	U
41	0603860F	Joint Precision Approach and Landing Systems - Dem/Val	04	57,975		57,975	U
42	0604015F	Long Range Strike	04	291,742		291,742	U
43	0604283F	Battle Mgmt Com & Ctrl Sensor Development	04	114,417		114,417	U
44	0604317F	Technology Transfer	04	2,576		2,576	U
45	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	16,711		16,711	U
46	0604330F	Joint Dual Role Air Dominance Missile	04				U
47	0604337F	Requirements Analysis and Maturation	04	16,343		16,343	U
48	0604422F	Weather Satellite Follow-on	04	2,000		2,000	U
49	0604436F	Next-Generation MILSATCOM Technology Development	04				U
50	0604635F	Ground Attack Weapons Fuze Development	04	9,423		9,423	U
51	0604775F	Defense Rapid Innovation Program	04				U
52	0604796F	Alternative Fuels	04				U
53	0604830F	Automated Air-to-Air Refueling	04				U
54	0604857F	Operationally Responsive Space	04				U
55	0604858F	Tech Transition Program	04	37,558		37,558	U
56	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	04	96,840		96,840	U
57	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04				U
		Advanced Component Development & Prototypes		1,181,177		1,181,177	
58	0603840F	Global Broadcast Service (GBS)	05	14,652		14,652	U
59	0604222F	Nuclear Weapons Support	05	25,713		25,713	U

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60	0604233F	Specialized Undergraduate Flight Training	05	7,794	21,780		21,780	U
61	0604270F	Electronic Warfare Development	05	86,955	16,880		16,880	U
62	0604280F	Joint Tactical Radio	05	628				U
63	0604281F	Tactical Data Networks Enterprise	05	192,882	47,057		47,057	U
64	0604287F	Physical Security Equipment	05	49	51		51	U
65	0604329F	Small Diameter Bomb (SDB) - EMD	05	99,992	132,881		132,881	U
66	0604421F	Counterspace Systems	05	37,994	31,578		31,578	U
67	0604425F	Space Situation Awareness Systems	05	318,652	238,261		238,261	U
68	0604429F	Airborne Electronic Attack	05	25,051	41,000		41,000	U
69	0604441F	Space Based Infrared System (SBIRS) High EMD	05	523,788	621,629		621,629	U
70	0604602F	Armament/Ordnance Development	05	6,659	7,755		7,755	U
71	0604604F	Submunitions	05	1,614	2,427		2,427	U
72	0604617F	Agile Combat Support	05	34,037	7,978		7,978	U
73	0604706F	Life Support Systems	05	10,340	9,280		9,280	U
74	0604735F	Combat Training Ranges	05	35,723	8,106		8,106	U
75	0604740F	Integrated Command & Control Applications (IC2A)	05	10	10		10	U
76	0604750F	Intelligence Equipment	05	1,357	995		995	U
77	0604800F	F-35 - EMD	05	931,599	1,387,926		1,387,926	U
78	0604851F	Intercontinental Ballistic Missile - EMD	05	66,342	148,307		148,307	U
79	0604853F	Evolved Expendable Launch Vehicle Program (SPACE) - EMD	05	53,786	14,524		14,524	U
80	0604932F	Long Range Standoff Weapon	05					U

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60	0604233F	Specialized Undergraduate Flight Training	05	6,583		6,583	U
61	0604270F	Electronic Warfare Development	05	1,975		1,975	U
62	0604280F	Joint Tactical Radio	05	2,594		2,594	U
63	0604281F	Tactical Data Networks Enterprise	05	24,534		24,534	U
64	0604287F	Physical Security Equipment	05	51		51	U
65	0604329F	Small Diameter Bomb (SDB) - EMD	05	143,000		143,000	U
66	0604421F	Counterspace Systems	05	28,797		28,797	U
67	0604425F	Space Situation Awareness Systems	05	267,252		267,252	U
68	0604429F	Airborne Electronic Attack	05	4,118		4,118	U
69	0604441F	Space Based Infrared System (SBIRS) High EMD	05	448,594		448,594	U
70	0604602F	Armament/Ordnance Development	05	9,951		9,951	U
71	0604604F	Submunitions	05	2,567		2,567	U
72	0604617F	Agile Combat Support	05	13,059		13,059	U
73	0604706F	Life Support Systems	05	9,720		9,720	U
74	0604735F	Combat Training Ranges	05	9,222		9,222	U
75	0604740F	Integrated Command & Control Applications (IC2A)	05				U
76	0604750F	Intelligence Equipment	05	803		803	U
77	0604800F	F-35 - EMD	05	1,210,306		1,210,306	U
78	0604851F	Intercontinental Ballistic Missile - EMD	05	135,437		135,437	U
79	0604853F	Evolved Expendable Launch Vehicle Program (SPACE) - EMD	05	7,980		7,980	U
80	0604932F	Long Range Standoff Weapon	05	2,004		2,004	U

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Line No	Program Element Number	Item	Act	FY 2011 Actuals	FY 2012 Base	FY 2012 OCO	FY 2012 Total	Se c
81	0604933F	ICBM Fuze Modernization	05					U
82	0605213F	F-22 Modernization Increment 3.2B	05					U
83	0605221F	Next Generation Aerial Refueling Aircraft	05	538,875	877,084		877,084	U
84	0605229F	CSAR HH-60 Recapitalization	05	11,924	11,113		11,113	U
85	0605278F	HC/MC-130 Recap RDT&E	05	15,008	22,071		22,071	U
86	0605931F	B-2 Defensive Management System	05					U
87	0101125F	Nuclear Weapons Modernization	05		93,867		93,867	U
88	0207100F	Light Attack Armed Reconnaissance (LAAR) Squadrons	05		13,721		13,721	U
89	0207604F	Readiness Training Ranges, Operations and Maintenance	05					U
90	0207701F	Full Combat Mission Training	05	55,539	29,826		29,826	U
91	0305230F	MC-12	05					U
92	0401138F	C-27J Airlift Squadrons	05	17,849	27,089		27,089	U
93	0401318F	CV-22	05	17,648	13,223		13,223	U
94	0401845F	Airborne Senior Leader C3 (SLC3S)	05	7,786				U
		System Development & Demonstration		3,185,265	3,850,525		3,850,525	
95	0604256F	Threat Simulator Development	06	24,805	22,420		22,420	U
96	0604759F	Major T&E Investment	06	59,469	62,206		62,206	U
97	0605101F	RAND Project Air Force	06	31,616	27,579		27,579	U
98	0605502F	Small Business Innovation Research	06	317,183				U
99	0605712F	Initial Operational Test & Evaluation	06	20,278	17,754		17,754	U
100	0605807F	Test and Evaluation Support	06	752,328	704,475		704,475	U

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81	0604933F	ICBM Fuze Modernization	05	73,512		73,512	U
82	0605213F	F-22 Modernization Increment 3.2B	05	140,100		140,100	U
83	0605221F	Next Generation Aerial Refueling Aircraft	05	1,815,588		1,815,588	U
84	0605229F	CSAR HH-60 Recapitalization	05	123,210		123,210	U
85	0605278F	HC/MC-130 Recap RDT&E	05	19,039		19,039	U
86	0605931F	B-2 Defensive Management System	05	281,056		281,056	U
87	0101125F	Nuclear Weapons Modernization	05	80,200		80,200	U
88	0207100F	Light Attack Armed Reconnaissance (LAAR) Squadrons	05				U
89	0207604F	Readiness Training Ranges, Operations and Maintenance	05	310		310	U
90	0207701F	Full Combat Mission Training	05	14,861		14,861	U
91	0305230F	MC-12	05	19,949		19,949	U
92	0401138F	C-27J Airlift Squadrons	05				U
93	0401318F	CV-22	05	28,027		28,027	U
94	0401845F	Airborne Senior Leader C3 (SLC3S)	05	1,960		1,960	U
		System Development & Demonstration		4,966,724		4,966,724	
95	0604256F	Threat Simulator Development	06	22,812		22,812	U
96	0604759F	Major T&E Investment	06	42,236		42,236	U
97	0605101F	RAND Project Air Force	06	25,579		25,579	U
98	0605502F	Small Business Innovation Research	06				U
99	0605712F	Initial Operational Test & Evaluation	06	16,197		16,197	U
100	0605807F	Test and Evaluation Support	06	722,071		722,071	U

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101	0605860F	Rocket Systems Launch Program (SPACE)	06	23,431	157,799		157,799	U
102	0605864F	Space Test Program (STP)	06	44,468	47,409		47,409	U
103	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	46,091	44,547		44,547	U
104	0605978F	Facilities Sustainment - Test and Evaluation Support	06	27,438	27,953		27,953	U
105	0606323F	Multi-Service Systems Engineering Initiative	06	18,258	13,953		13,953	U
106	0606392F	Space and Missile Center (SMC) Civilian Workforce	06		187,096		187,096	U
107	0702806F	Acquisition and Management Support	06	24,074	31,962		31,962	U
108	0804731F	General Skill Training	06	1,491	1,510		1,510	U
109	0909980F	Judgment Fund Reimbursement	06	371				U
110	0909999F	Financing for Cancelled Account Adjustments	06	1,468				U
111	1001004F	International Activities	06	3,636	3,798		3,798	U
	RDT&E	Management Support		1,396,405	1,350,461		1,350,461	
112	0603423F	Global Positioning System III - Operational Control Segment	07	353,623	362,823		362,823	U
113	0604263F	Common Vertical Lift Support Platform	07	3,980	5,365		5,365	U
114	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	07	22,471	91,640		91,640	U
115	0605024F	Anti-Tamper Technology Executive Agency	07	40,936	35,245		35,245	U
117	0101113F	B-52 Squadrons	07	129,864	93,808		93,808	U
118	0101122F	Air-Launched Cruise Missile (ALCM)	07	3,518	803		803	U
119	0101126F	B-1B Squadrons	07	33,063	33,011		33,011	U
120	0101127F	B-2 Squadrons	07	244,732	280,319		280,319	U
121	0101313F	Strat War Planning System - USSTRATCOM	07	30,133	22,791		22,791	U

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101	0605860F	Rocket Systems Launch Program (SPACE)	06	16,200		16,200	U
102	0605864F	Space Test Program (STP)	06	10,051		10,051	U
103	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	42,597		42,597	U
104	0605978F	Facilities Sustainment - Test and Evaluation Support	06	27,301		27,301	U
105	0606323F	Multi-Service Systems Engineering Initiative	06	13,964		13,964	U
106	0606392F	Space and Missile Center (SMC) Civilian Workforce	06	203,766		203,766	U
107	0702806F	Acquisition and Management Support	06	42,430		42,430	U
108	0804731F	General Skill Training	06	1,294		1,294	U
109	0909980F	Judgment Fund Reimbursement	06				U
110	0909999F	Financing for Cancelled Account Adjustments	06				U
111	1001004F	International Activities	06	3,851		3,851	U
	RDT&E Management Support			1,190,349		1,190,349	
112	0603423F	Global Positioning System III - Operational Control Segment	07	371,595		371,595	U
113	0604263F	Common Vertical Lift Support Platform	07				U
114	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	07	91,697		91,697	U
115	0605024F	Anti-Tamper Technology Executive Agency	07	17,037		17,037	U
117	0101113F	B-52 Squadrons	07	53,208		53,208	U
118	0101122F	Air-Launched Cruise Missile (ALCM)	07	431		431	U
119	0101126F	B-1B Squadrons	07	16,265		16,265	U
120	0101127F	B-2 Squadrons	07	35,970		35,970	U
121	0101313F	Strat War Planning System - USSTRATCOM	07	30,889		30,889	U

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122	0101314F	Night Fist - USSTRATCOM	07	5,332	2,000		2,000	U
124	0102326F	Region/Sector Operation Control Center Modernization Program	07	20,022	6,466		6,466	U
125	0102823F	Strategic Aerospace Intelligence System Activities	07	15	14		14	U
126	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	10,178	19,892		19,892	U
127	0205219F	MQ-9 UAV	07	136,667	126,730		126,730	U
128	0207040F	Multi-Platform Electronic Warfare Equipment	07	15,045				U
129	0207131F	A-10 Squadrons	07	5,485	11,051		11,051	U
130	0207133F	F-16 Squadrons	07	125,417	131,069		131,069	U
131	0207134F	F-15E Squadrons	07	200,966	194,831		194,831	U
132	0207136F	Manned Destructive Suppression	07	12,496	13,253		13,253	U
133	0207138F	F-22A Squadrons	07	493,506	571,320		571,320	U
134	0207142F	F-35 Squadrons	07		9,967		9,967	U
135	0207161F	Tactical AIM Missiles	07	5,834	8,023		8,023	U
136	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	60,834	77,830		77,830	U
137	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	2,330	1,436		1,436	U
138	0207224F	Combat Rescue and Recovery	07	912	2,292		2,292	U
139	0207227F	Combat Rescue - Pararescue	07	2,821	927		927	U
140	0207247F	AF TENCAP	07	11,589	20,727		20,727	U
141	0207249F	Precision Attack Systems Procurement	07	2,915	3,128		3,128	U
142	0207253F	Compass Call	07	19,949	18,509		18,509	U
143	0207268F	Aircraft Engine Component Improvement Program	07	115,290	172,967		172,967	U

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122	0101314F	Night Fist - USSTRATCOM	07	10		10	U
124	0102326F	Region/Sector Operation Control Center Modernization Program	07	5,609		5,609	U
125	0102823F	Strategic Aerospace Intelligence System Activities	07				U
126	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	15,098		15,098	U
127	0205219F	MQ-9 UAV	07	147,971		147,971	U
128	0207040F	Multi-Platform Electronic Warfare Equipment	07	49,848		49,848	U
129	0207131F	A-10 Squadrons	07	13,538		13,538	U
130	0207133F	F-16 Squadrons	07	190,257		190,257	U
131	0207134F	F-15E Squadrons	07	192,677		192,677	U
132	0207136F	Manned Destructive Suppression	07	13,683		13,683	U
133	0207138F	F-22A Squadrons	07	371,667		371,667	U
134	0207142F	F-35 Squadrons	07	8,117		8,117	U
135	0207161F	Tactical AIM Missiles	07	8,234		8,234	U
136	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	87,041		87,041	U
137	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	1,472		1,472	U
138	0207224F	Combat Rescue and Recovery	07	2,095		2,095	U
139	0207227F	Combat Rescue - Pararescue	07	1,119		1,119	U
140	0207247F	AF TENCAP	07	63,853		63,853	U
141	0207249F	Precision Attack Systems Procurement	07	1,063		1,063	U
142	0207253F	Compass Call	07	12,094		12,094	U
143	0207268F	Aircraft Engine Component Improvement Program	07	187,984		187,984	U

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144	0207277F	ISR Innovations	07	115,300		50,000	50,000	U
145	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	19,324	5,796		5,796	U
146	0207410F	Air & Space Operations Center (AOC)	07	89,867	120,670		120,670	U
147	0207412F	Control and Reporting Center (CRC)	07	52,120	3,387		3,387	U
148	0207417F	Airborne Warning and Control System (AWACS)	07	201,838	117,880		117,880	U
149	0207418F	Tactical Airborne Control Systems	07		8,309		8,309	U
150	0207423F	Advanced Communications Systems	07	52,480	43,964		43,964	U
152	0207431F	Combat Air Intelligence System Activities	07	4,593	5,428		5,428	U
153	0207438F	Theater Battle Management (TBM) C4I	07	14,640	15,485		15,485	U
154	0207444F	Tactical Air Control Party-Mod	07		9,515		9,515	U
155	0207445F	Fighter Tactical Data Link	07	22,756				U
156	0207448F	C2ISR Tactical Data Link	07	1,528	1,522		1,522	U
157	0207449F	Command and Control (C2) Constellation	07	25,039	17,254		17,254	U
158	0207452F	DCAPES	07					U
159	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	162,756	74,018		74,018	U
160	0207590F	Seek Eagle	07	19,165	18,599		18,599	U
161	0207601F	USAF Modeling and Simulation	07	20,800	22,990		22,990	U
162	0207605F	Wargaming and Simulation Centers	07	5,829	5,779		5,779	U
163	0207697F	Distributed Training and Exercises	07	2,759	3,247		3,247	U
164	0208006F	Mission Planning Systems	07	80,492	63,009		63,009	U
165	0208021F	Information Warfare Support	07	2,152	2,314		2,314	U

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144	0207277F	ISR Innovations	07				U
145	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	7,950		7,950	U
146	0207410F	Air & Space Operations Center (AOC)	07	76,315		76,315	U
147	0207412F	Control and Reporting Center (CRC)	07	8,653		8,653	U
148	0207417F	Airborne Warning and Control System (AWACS)	07	65,200		65,200	U
149	0207418F	Tactical Airborne Control Systems	07	5,767		5,767	U
150	0207423F	Advanced Communications Systems	07				U
152	0207431F	Combat Air Intelligence System Activities	07	5,756		5,756	U
153	0207438F	Theater Battle Management (TBM) C4I	07				U
154	0207444F	Tactical Air Control Party-Mod	07	16,226		16,226	U
155	0207445F	Fighter Tactical Data Link	07				U
156	0207448F	C2ISR Tactical Data Link	07	1,633		1,633	U
157	0207449F	Command and Control (C2) Constellation	07	18,086		18,086	U
158	0207452F	DCAPES	07	15,690		15,690	U
159	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	24,241		24,241	U
160	0207590F	Seek Eagle	07	22,654		22,654	U
161	0207601F	USAF Modeling and Simulation	07	15,501		15,501	U
162	0207605F	Wargaming and Simulation Centers	07	5,699		5,699	U
163	0207697F	Distributed Training and Exercises	07	4,425		4,425	U
164	0208006F	Mission Planning Systems	07	69,377		69,377	U
165	0208021F	Information Warfare Support	07	7,159		7,159	U

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166	0208059F	Cyber Command Activities	07	18,039	702		702	U
174	0301400F	Space Superiority Intelligence	07	9,955	8,866		8,866	U
175	0302015F	E-4B National Airborne Operations Center (NAOC)	07	12,105	4,845		4,845	U
176	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	67,912	43,360		43,360	U
177	0303140F	Information Systems Security Program	07	123,348	91,657		91,657	U
178	0303141F	Global Combat Support System	07	3,376	449		449	U
179	0303150F	Global Command and Control System	07	4,846	3,825		3,825	U
180	0303601F	MILSATCOM Terminals	07	298,736	236,581		236,581	U
182	0304260F	Airborne SIGINT Enterprise	07	159,462	108,248		108,248	U
185	0305099F	Global Air Traffic Management (GATM)	07	5,679	4,604		4,604	U
186	0305103F	Cyber Security Initiative	07	1,961	1,981		1,981	U
187	0305105F	DoD Cyber Crime Center	07	270	282		282	U
188	0305110F	Satellite Control Network (SPACE)	07	25,652	18,143		18,143	U
189	0305111F	Weather Service	07	32,116	30,919		30,919	U
190	0305114F	Air Traffic Control, Approach, and Landing System (ATCAL)	07	26,209	20,644		20,644	U
191	0305116F	Aerial Targets	07	60,574	45,620		45,620	U
194	0305128F	Security and Investigative Activities	07	454	366		366	U
195	0305145F	Arms Control Implementation	07					U
196	0305146F	Defense Joint Counterintelligence Activities	07	40	39		39	U
198	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	155,778	131,832		131,832	U
199	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	33,404	17,704		17,704	U

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166	0208059F	Cyber Command Activities	07	66,888		66,888	U
174	0301400F	Space Superiority Intelligence	07	12,056		12,056	U
175	0302015F	E-4B National Airborne Operations Center (NAOC)	07	4,159		4,159	U
176	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	20,124		20,124	U
177	0303140F	Information Systems Security Program	07	69,133		69,133	U
178	0303141F	Global Combat Support System	07	6,512		6,512	U
179	0303150F	Global Command and Control System	07	4,316		4,316	U
180	0303601F	MILSATCOM Terminals	07	107,237		107,237	U
182	0304260F	Airborne SIGINT Enterprise	07	129,106		129,106	U
185	0305099F	Global Air Traffic Management (GATM)	07	4,461		4,461	U
186	0305103F	Cyber Security Initiative	07	2,055		2,055	U
187	0305105F	DoD Cyber Crime Center	07	285		285	U
188	0305110F	Satellite Control Network (SPACE)	07	33,773		33,773	U
189	0305111F	Weather Service	07	29,048		29,048	U
190	0305114F	Air Traffic Control, Approach, and Landing System (ATCAL)	07	43,187		43,187	U
191	0305116F	Aerial Targets	07	50,496		50,496	U
194	0305128F	Security and Investigative Activities	07	354		354	U
195	0305145F	Arms Control Implementation	07	4,000		4,000	U
196	0305146F	Defense Joint Counterintelligence Activities	07	342		342	U
198	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	29,621		29,621	U
199	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	14,335		14,335	U

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201	0305173F	Space and Missile Test and Evaluation Center	07	4,270	1,629		1,629	U
202	0305174F	Space Innovation and Development Center	07	2,905	2,952		2,952	U
203	0305182F	Spacelift Range System (SPACE)	07	9,260	9,877		9,877	U
204	0305193F	Intelligence Support to Information Operations (IO)	07	1,248	1,271		1,271	U
205	0305202F	Dragon U-2	07					U
206	0305205F	Endurance Unmanned Aerial Vehicles	07	65,844	45,925	82,000	127,925	U
207	0305206F	Airborne Reconnaissance Systems	07	243,161	103,877		103,877	U
208	0305207F	Manned Reconnaissance Systems	07	15,259	13,049		13,049	U
209	0305208F	Distributed Common Ground/Surface Systems	07	94,272	85,724		85,724	U
210	0305219F	MQ-1 Predator A UAV	07	42,776	11,642		11,642	U
211	0305220F	RQ-4 UAV	07	218,912	423,462		423,462	U
212	0305221F	Network-Centric Collaborative Targeting	07	13,330	7,348		7,348	U
213	0305236F	Common Data Link (CDL)	07					U
214	0305238F	NATO AGS	07					U
215	0305240F	Support to DCGS Enterprise	07					U
216	0305265F	GPS III Space Segment	07	430,132	455,095		455,095	U
217	0305614F	JSpOC Mission System	07	98,726	80,409		80,409	U
218	0305881F	Rapid Cyber Acquisition	07					U
219	0305887F	Intelligence Support to Information Warfare	07	8,994	14,547		14,547	U
220	0305913F	NUDET Detection System (SPACE)	07	71,347	81,989		81,989	U
221	0305940F	Space Situation Awareness Operations	07	40,918	31,956		31,956	U

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Line No	Program Element Number	Item	Act	FY 2013 Base	FY 2013 OCO	FY 2013 Total	Se c
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201	0305173F	Space and Missile Test and Evaluation Center	07	3,680		3,680	U
202	0305174F	Space Innovation and Development Center	07	2,430		2,430	U
203	0305182F	Spacelift Range System (SPACE)	07	8,760		8,760	U
204	0305193F	Intelligence Support to Information Operations (IO)	07				U
205	0305202F	Dragon U-2	07	23,644		23,644	U
206	0305205F	Endurance Unmanned Aerial Vehicles	07	21,000		21,000	U
207	0305206F	Airborne Reconnaissance Systems	07	96,735		96,735	U
208	0305207F	Manned Reconnaissance Systems	07	13,316		13,316	U
209	0305208F	Distributed Common Ground/Surface Systems	07	63,501		63,501	U
210	0305219F	MQ-1 Predator A UAV	07	9,122		9,122	U
211	0305220F	RQ-4 UAV	07	236,265		236,265	U
212	0305221F	Network-Centric Collaborative Targeting	07	7,367		7,367	U
213	0305236F	Common Data Link (CDL)	07	38,094		38,094	U
214	0305238F	NATO AGS	07	210,109		210,109	U
215	0305240F	Support to DCGS Enterprise	07	24,500		24,500	U
216	0305265F	GPS III Space Segment	07	318,992		318,992	U
217	0305614F	JSpOC Mission System	07	54,645		54,645	U
218	0305881F	Rapid Cyber Acquisition	07	4,007		4,007	U
219	0305887F	Intelligence Support to Information Warfare	07	13,357		13,357	U
220	0305913F	NUDET Detection System (SPACE)	07	64,965		64,965	U
221	0305940F	Space Situation Awareness Operations	07	19,586		19,586	U

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Line No	Program Element Number	Item	Act	FY 2011 Actuals	FY 2012 Base	FY 2012 OCO	FY 2012 Total	S e c
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222	0307141F	Information Operations Technology Integration & Tool Development	07	21,143	23,920		23,920	U
223	0308699F	Shared Early Warning (SEW)	07	2,858	1,663		1,663	U
224	0401115F	C-130 Airlift Squadron	07	42,067	6,509		6,509	U
225	0401119F	C-5 Airlift Squadrons (IF)	07	55,071	12,941		12,941	U
226	0401130F	C-17 Aircraft (IF)	07	156,943	93,777		93,777	U
227	0401132F	C-130J Program	07	25,943	39,537		39,537	U
228	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	17,139	7,438		7,438	U
229	0401139F	Light Mobility Aircraft (LiMA)	07					U
230	0401218F	KC-135s	07	19,887	6,161		6,161	U
231	0401219F	KC-10s	07	41,456	30,868		30,868	U
232	0401314F	Operational Support Airlift	07	4,819	42,591		42,591	U
233	0401315F	C-STOL Aircraft	07	1,239				U
234	0408011F	Special Tactics / Combat Control	07	17,557	5,155		5,155	U
235	0702207F	Depot Maintenance (Non-IF)	07	1,462	1,531		1,531	U
236	0708012F	Logistics Support Activities	07		944		944	U
237	0708610F	Logistics Information Technology (LOGIT)	07	217,584	139,885		139,885	U
238	0708611F	Support Systems Development	07	40,668	50,990		50,990	U
239	0801711F	Recruiting Activities	07	5,074				U
240	0804743F	Other Flight Training	07	644	322		322	U
241	0804757F	Joint National Training Center	07	9	11		11	U
242	0808716F	Other Personnel Activities	07	112	113		113	U

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Line No	Program Element Number	Item	Act	FY 2013 Base	FY 2013 OCO	FY 2013 Total	Se
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222	0307141F	Information Operations Technology Integration & Tool Development	07				U
223	0308699F	Shared Early Warning (SEW)	07	1,175		1,175	U
224	0401115F	C-130 Airlift Squadron	07	5,000		5,000	U
225	0401119F	C-5 Airlift Squadrons (IF)	07	35,115		35,115	U
226	0401130F	C-17 Aircraft (IF)	07	99,225		99,225	U
227	0401132F	C-130J Program	07	30,652		30,652	U
228	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	7,758		7,758	U
229	0401139F	Light Mobility Aircraft (LiMA)	07	100		100	U
230	0401218F	KC-135s	07				U
231	0401219F	KC-10s	07	24,022		24,022	U
232	0401314F	Operational Support Airlift	07	7,471		7,471	U
233	0401315F	C-STOL Aircraft	07				U
234	0408011F	Special Tactics / Combat Control	07	4,984		4,984	U
235	0702207F	Depot Maintenance (Non-IF)	07	1,588		1,588	U
236	0708012F	Logistics Support Activities	07	577		577	U
237	0708610F	Logistics Information Technology (LOGIT)	07	119,327		119,327	U
238	0708611F	Support Systems Development	07	15,873		15,873	U
239	0801711F	Recruiting Activities	07				U
240	0804743F	Other Flight Training	07	349		349	U
241	0804757F	Joint National Training Center	07				U
242	0808716F	Other Personnel Activities	07	117		117	U

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Line No	Program Element Number	Item	Act	FY 2011 Actuals	FY 2012 Base	FY 2012 OCO	FY 2012 Total	S e c
243	0901202F	Joint Personnel Recovery Agency	07	5,899	2,483		2,483	U
244	0901218F	Civilian Compensation Program	07	7,771	1,508		1,508	U
245	0901220F	Personnel Administration	07	10,765	1,041		1,041	U
246	0901226F	Air Force Studies and Analysis Agency	07		928		928	U
247	0901279F	Facilities Operation - Administrative	07		12,118		12,118	U
248	0901538F	Financial Management Information Systems Development	07	48,087	76,207		76,207	U
249	0902998F	Management HQ - ADP Support (AF)	07		299		299	U
9999	9999999999	Classified Programs		12,967,171	11,899,828	69,000	11,968,828	U
		Operational Systems Development		19,115,999	17,457,590	201,000	17,658,590	
Total Research, Development, Test & Eval, AF				27,421,360	26,480,201	259,600	26,739,801	

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Line No	Program Element Number	Item	Act	FY 2013 Base	FY 2013 OCO	FY 2013 Total	Se
243	0901202F	Joint Personnel Recovery Agency	07	2,018		2,018	U
244	0901218F	Civilian Compensation Program	07	1,561		1,561	U
245	0901220F	Personnel Administration	07	7,634		7,634	U
246	0901226F	Air Force Studies and Analysis Agency	07	1,175		1,175	U
247	0901279F	Facilities Operation - Administrative	07	3,491		3,491	U
248	0901538F	Financial Management Information Systems Development	07	100,160		100,160	U
249	0902998F	Management HQ - ADP Support (AF)	07				U
9999	9999999999	Classified Programs		11,172,183	53,150	11,225,333	U
		Operational Systems Development		15,867,972	53,150	15,921,122	
Total Research, Development, Test & Eval, AF				25,428,046	53,150	25,481,196	



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***Appropriation 3600: Research, Development, Test & Evaluation, Air Force***

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1	01	0601102F	Defense Research Sciences.....	Volume 1 - 1
2	01	0601103F	University Research Initiatives.....	Volume 1 - 49
3	01	0601108F	High Energy Laser Research Initiatives.....	Volume 1 - 53

***Budget Activity 02: Applied Research***  
***Appropriation 3600: Research, Development, Test & Evaluation, Air Force***

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<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
4	02	0602102F	Materials.....	Volume 1 - 57
5	02	0602201F	Aerospace Vehicle Technologies.....	Volume 1 - 79
6	02	0602202F	Human Effectiveness Applied Research.....	Volume 1 - 93
7	02	0602203F	Aerospace Propulsion.....	Volume 1 - 117
8	02	0602204F	Aerospace Sensors.....	Volume 1 - 149
9	02	0602601F	Space Technology.....	Volume 1 - 175

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**Budget Activity 02: Applied Research**  
**Appropriation 3600: Research, Development, Test & Evaluation, Air Force**

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10	02	0602602F	Conventional Munitions.....	Volume 1 - 193
11	02	0602605F	DIRECTED ENERGY TECHNOLOGY.....	Volume 1 - 203
12	02	0602788F	Dominant Information Technology.....	Volume 1 - 211
13	02	0602890F	High Energy Laser Research.....	Volume 1 - 231

**Budget Activity 03: Advanced Technology Development (ATD)**  
**Appropriation 3600: Research, Development, Test & Evaluation, Air Force**

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<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
14	03	0603112F	Advanced Materials for Weapon Systems.....	Volume 1 - 237
15	03	0603199F	Sustainment Science and Technology (S&T).....	Volume 1 - 251
16	03	0603203F	Advanced Aerospace Sensors.....	Volume 1 - 255
17	03	0603211F	Aerospace Technology Dev/Demo.....	Volume 1 - 269
18	03	0603216F	Aerospace Propulsion and Power Technology.....	Volume 1 - 275
19	03	0603270F	Electronic Combat Technology.....	Volume 1 - 299
20	03	0603401F	Advanced Spacecraft Technology.....	Volume 1 - 309
21	03	0603444F	MAUI SPACE SURVEILLANCE SYSTEM.....	Volume 1 - 329

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***Budget Activity 03: Advanced Technology Development (ATD)***  
***Appropriation 3600: Research, Development, Test & Evaluation, Air Force***

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<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
22	03	0603456F	Human Effectiveness Adv Tech Dev.....	Volume 1 - 333
23	03	0603601F	Conventional Weapons Technology.....	Volume 1 - 353
24	03	0603605F	Advanced Weapons Technology.....	Volume 1 - 357
25	03	0603680F	Manufacturing Technologies.....	Volume 1 - 365
26	03	0603788F	Global Information Dev/Demo.....	Volume 1 - 373
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Advanced Spacecraft Technology	0603401F	20	03.....	Volume 1 - 309
Advanced Weapons Technology	0603605F	24	03.....	Volume 1 - 357
Aerospace Propulsion	0602203F	7	02.....	Volume 1 - 117
Aerospace Propulsion and Power Technology	0603216F	18	03.....	Volume 1 - 275
Aerospace Sensors	0602204F	8	02.....	Volume 1 - 149
Aerospace Technology Dev/Demo	0603211F	17	03.....	Volume 1 - 269
Aerospace Vehicle Technologies	0602201F	5	02.....	Volume 1 - 79
Conventional Munitions	0602602F	10	02.....	Volume 1 - 193
Conventional Weapons Technology	0603601F	23	03.....	Volume 1 - 353
DIRECTED ENERGY TECHNOLOGY	0602605F	11	02.....	Volume 1 - 203
Defense Research Sciences	0601102F	1	01.....	Volume 1 - 1
Dominant Information Technology	0602788F	12	02.....	Volume 1 - 211
Electronic Combat Technology	0603270F	19	03.....	Volume 1 - 299
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High Energy Laser Research Initiatives	0601108F	3	01.....	Volume 1 - 53
Human Effectiveness Adv Tech Dev	0603456F	22	03.....	Volume 1 - 333
Human Effectiveness Applied Research	0602202F	6	02.....	Volume 1 - 93
MAUI SPACE SURVEILLANCE SYSTEM	0603444F	21	03.....	Volume 1 - 329
Manufacturing Technologies	0603680F	25	03.....	Volume 1 - 365
Materials	0602102F	4	02.....	Volume 1 - 57
Space Technology	0602601F	9	02.....	Volume 1 - 175
Sustainment Science and Technology (S&T)	0603199F	15	03.....	Volume 1 - 251
University Research Initiatives	0601103F	2	01.....	Volume 1 - 49

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**The following Program Elements are not providing RDT&E exhibits due to classification:**

0101314F	NIGHT FIRST-USSSTRATCOM
0101815F	ADVANCED STRATEGIC PROGRAM
0207424F	EVALUATION AND ANALYSIS PROGRAM
0208161F	SPECIAL EVALUATION SYSTEM
0208162F	ADVANCED TECHNOLOGY PROGRAM
0301310F	NATIONAL AIR INTELLIGENCE CENTER
0301314F	COBRA BALL
0301315F	MISSILE AND SPACE TECHICAL COLLECTION
0301324F	FOREST GREEN
0301386F	GDIP COLLECTION MANAGEMENT
0304111F	SPECIAL ACTIVITES
0304311F	SELECTED ACTIVITIES
0304348F	ADVANCED GEOSPATIAL INTELLIGENCE(AGI)
0305124F	SPECIAL APPLICATIONS PROGRAM
0305159F	DEFENSE RECONNAISSANCE SUPPORT ACTIVITIES
0305172F	COMBINED ADVANCED APPLICATIONS
0605798F	ANALYSIS SUPPORT GROUP
0305127F	FOREIGN COUNTERINTELLIGENCE ACTIVITES

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**PROGRAM ELEMENT COMPARISON SUMMARY**

**PROGRAM ELEMENT (BY BUDGET ACTIVITY)**

**BUDGET ACTIVITY #2: APPLIED RESEARCH (Volume 1)**

0602202F

**HUMAN EFFECTIVENESS APPLIED RESEARCH**

**Remarks**

In FY13, Measurement and Signature Intelligence (MASINT) moves from Project 627184 to this Project to better align the efforts. Also in FY13, the efforts in this Project move into Projects 625328, 625329, and 627757 to better align the efforts.

0602602F

**CONVENTIONAL MUNITIONS**

In FY13, changes in funding are due to higher DoD priorities.

0602890F

**HIGH ENERGY LASER RESEARCH**

In FY13, reductions due to higher Department of Defense priorities.

**BUDGET ACTIVITY #3: ADVANCED TECHNOLOGY DEVELOPMENT (Volume 1)**

0603456F

**HUMAN EFFECT. ADV TECH DEVELOPMENT**

In FY13, Project 635326, Performance Enhancement Demonstration, moves to Project 635324, Human Dynamics and Terrain Demonstration, to better align efforts

0603601F

**CONVENTIONAL WEAPONS TECHNOLOGY**

In FY13, changes are due to higher DoD priorities.

**BUDGET ACTIVITY #4: ADVANCED COMPONENT DEVELOPMENT AND PROTOTYPE (Volume 2)**

0305164F

**NAVSTAR GLO POS SYS(USER EQ)(SPACE)**

In FY13, Military GPS User Equipment (MGUE) funding is transferred to this project in PE 0305164F.

0603851F

**ICBM - DEM/VAL**

In FY13, Project 641025 Ground Based Strategic Deterrence (GBSD) includes efforts to begin Materiel Solution Analysis and the Analysis of Alternatives (AoA) for a follow-on to the Minuteman III Intercontinental Ballistic Mssile (ICBM). This is not a new start, efforts previously funded under project 644209 Long Range Planning.

0604330F

**JNT DUAL ROLE AIR DOMINANCE MISSILE**

In FY13, PE 0604330F, Joint Dual-Role Air Dominance Missile (JDRADM) was terminated.

0604857F

**OPERATIONALLY RESPONSIVE SPACE**

In FY13, 0604857F, ORS, efforts are being descoped, and the remaining efforts transferred to other space programs in order to better integrate the ORS concept into the entire space architecture.

**PROGRAM ELEMENT (BY BUDGET ACTIVITY)**

**PROGRAM ELEMENT COMPARISON SUMMARY**

**BUDGET ACTIVITY #5: SYSTEM DEVELOPMENT AND  
DEMONSTRATION (SDD) (Volume 2)**

<b>0101125F</b>	<b>NUCLEAR WEAPONS MODERNIZATION</b>	In FY13, LRSO efforts were transferred from PE 0101125F, Nuclear Weapon Modernization, project number 657008, to PE 0604932F, Long Range Standoff Weapon, project number 657011.
<b>0305230F</b>	<b>ISR FOR IRREGULAR WARFARE</b>	In FY13, 654673, Distributed Mission Training includes new start efforts.
<b>0401138F</b>	<b>C-27J AIRLIFT SQUADRONS</b>	In FY13, Project 655259, C-27J, is terminated.
<b>0604270F</b>	<b>ELECTRONIC WARFARE DEVELOPMENT</b>	In FY13, Project 657004, MALD-J Increment II is terminated.
<b>0604429F</b>	<b>AIRBORNE ELECTRONIC ATTACK</b>	In FY13, Project 655193, Electronic Attack Pod, was terminated.
<b>0604617F</b>	<b>AGILE COMBAT SUPPORT</b>	In FY13, Project 652895 contains one New Start effort for Airfield Damage Repair Unexploded Ordnance (UXO) Removal.
<b>0604706F</b>	<b>LIFE SUPPORT SYSTEMS</b>	In FY13, Project 65412A, Life Support Systems, includes new starts for Cold Weather Aviation System (CWAS) and Integrated Aircrew Body Armor System programs.
<b>0604851F</b>	<b>ICBM - EMD</b>	In FY13, Project Number 657006, ICBM EMD: Fuze Support, was transferred to PE 0604933F in order to distinguish the effort as a pre-ACAT I program. In FY13, Project Number 655037, Support Equipment, includes the Transporter Erector (TE) Replacement new start effort. In FY13, Project Number 657010, Operational Equipment includes the Solid Rocket Motor Modernization new start to begin requirements definition to support a future production program.
<b>0604932F</b>	<b>LONG RANGE STANDOFF WEAPON</b>	In FY13, LRSO efforts were transferred from PE 0101125F, Nuclear Weapon Modernization, project number 657008 to PE 0604932F, Long Range Standoff Weapon, project number 657011, in order to support LRSO development.
<b>0604933F</b>	<b>ICBM FUZE MODERNIZATION</b>	In FY13, the fuze efforts in Project Number 655082, ICBM Fuze Support, were transferred from PE 0604851F ICBM - EMD, in order to distinguish the effort as an pre-ACAT I program.
<b>0605213F</b>	<b>F-22 INCREMENT 3.2B</b>	In FY13, this is not a New Start. A separate Program Element has been created for Increment 3.2B in support of milestone B preparations. All Increment 3.2B efforts and funding prior to FY13 continue to be shown in this F-22 baseline documentation.

**PROGRAM ELEMENT (BY BUDGET ACTIVITY)**

**PROGRAM ELEMENT COMPARISON SUMMARY**

**BUDGET ACTIVITY #7: OPERATIONAL SYSTEM DEVELOPMENT  
(Volume 3)**

<b>0101113F</b>	<b>B-52 SQUADRON</b>	<p>In FY13, SEPARATE BPACs HAVE BEEN ESTABLISHED AS FOLLOWS: 675039 B-52 MODERNIZATION 675048 1760 INTERNAL WEAPONS BAY UPGRADE (IWBU) 675049 MODE S/5 IFF 675050 CONECT 675051 B-52 ANTI-SKID In FY13, The EHF and SR2 programs are terminated for higher DoD priorities.</p>
<b>0101127F</b>	<b>B-2 SQUADRONS</b>	<p>In FY13, B-2 Defensive Management System (DMS) funding in PE 0101127F project 676023 was transferred to PE 0605931F, project 653844.</p>
<b>0101313F</b>	<b>STRAT WAR PLANNING SYS - USSTRATCOM</b>	<p>In FY13, 675282, Joint Navigation Warfare Center, efforts transferred to PE 0105921F, Service Support to STRATCOM Space Activities (O&amp;M).</p>
<b>0207133F</b>	<b>F-16 SQUADRONS</b>	<p>In FY13, Presidents Budget(PB) separates this combined effort into a separate Legacy SLEP for structures upgrades and separate Combat Avionics Programmed Extension Suite (CAPES) for avionics modernization upgrades.</p>
<b>0207134F</b>	<b>F-15E SQUADRONS</b>	<p>In FY13, the F-15 program, Project 670131 has one FY 2013 new start, the F-15 Eagle Passive/Active Warning Survivability System (EPAWSS).</p>
<b>0207138F</b>	<b>F-22A SQUADRONS</b>	<p>In FY13, a separate Program Element has been created for Increment 3.2B in support of milestone B preparations. All Increment 3.2B efforts and funding prior to FY13 continue to be shown in this F-22 baseline documentation.</p>
<b>0207325F</b>	<b>JOINT AIR-TO-SURFACE STANDOFF MISSIL</b>	<p>In FY13, BPAC 674515 is not an FY13 New Start. Efforts previously accomplished in BPAC 5356.</p>
<b>0207423F</b>	<b>ADV COMM SYS</b>	<p>In FY13, Project number 675189, C2ISR JTRS Integration, was terminated.</p>
<b>0207438F</b>	<b>THEATER BATTLE MANAGEMENT (TBM) C4I</b>	<p>In FY13, Project Number 674802, Deliberate and Crisis Action Planning and Execution Segment (DCAPES), was transferred to PE 0207452F DCAPES, Project Number 674802, Deliberate and Crisis Action Planning and Execution Segment (DCAPES), in order to provide clarity to the effort by providing a singular PE and Project Number.</p>

PROGRAM ELEMENT (BY BUDGET ACTIVITY)	PROGRAM ELEMENT COMPARISON SUMMARY	
0207452F	DCAPES	In FY13, Project Number 674802, Deliberate and Crisis Action Planning and Execution Segment (DCAPES), efforts transferred from PE 0207438, Theater Battle Management (TBM) C4I, Project Number 674802, Deliberate and Crisis Action Planning and Execution Segment (DCAPES), in order to provide clarity to the effort by providing a singular PE and Project Number.
0207601F	USAF MODELING AND SIMULATION	In FY13, Project 4991, Accelerated Acquisition was terminated.
0208006F	MISSION PLANNING SYSTEMS	In FY13, Project 675838 was renamed Mission Planning Systems Development from Mission Planning Systems. Project 675302 was renamed Precision Aerial Delivery Systems (PADS) from Mobility Air Forces (MAF) Planning Systems in FY13. Project 675380 was renamed Mission Planning Systems (MPS) Modernization from Combat Air Forces (CAF) Planning Systems in FY13.
0208021F	INFORMATION WARFARE SUPPORT	In FY13, 670374, Electronic Combat Spt, C3 Protection/Multi-Mission, Technology and Spt, includes new start efforts.
0208059F	CYBER COMMAND ACTIVITIES	In FY13, 676002, Cyber Systems Modernization, efforts were transferred from PE 0307141F, NASS, IO Tech Integration & Tool Dev, 674871, Information Operations Technology, in order to align all CYBERCOM funding into one PE.
0301400F	SPACE SUPERIORITY INTELLIGENCE	In FY13 PB, all of PE 0301400F RDT&E AF funds are transferred to project 67A051, Space Superiority -- Advanced Intelligence Systems to separate it from unrelated programs.
0303131F	MIN ESSENT EMGNCY COMM NTWK (MEECN)	In FY13, Nuclear Command, Control, and Communications (NC3) Long Term Solution (LTS) was cancelled during FY13 budget development due to higher DoD priorities.
0303141F	GLOBAL COMBAT SUPPORT SYSTEM	In FY13, Program Element (PE) 0303141F, Global Combat Support Systems - Air Force includes a new start effort to add Enterprise Protection Risk Management (EPRM) as an automated risk analysis and management tool on the GCSS-AF Integrated Framework (IF).
0305164F	NAVSTAR GLO POS SYS(USER EQ)(SPACE)	In FY13, funds for Military GPS User Equipment (MGUE) are transferred to Project 643833 in this Program Element (PE).
0305193F	INTEL SPT TO INFO OPS (IO)	In FY13, 674871, Information Operations Technology, efforts transferred to PE 0208059F, CYBERCOM Activities, 676002, Cyber Systems Modernization, in order to align all CYBERCOM funding into one PE.
0305202F	DRAGON U-2	In FY13, Project 674820, Sensor Development, includes new start efforts.
0305205F	ENDURANCE UNMANNED AERIAL VEHICLES	In FY13, funding totals do not currently include \$29.7M requested for Overseas Contingency Operations.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)	PROGRAM ELEMENT COMPARISON SUMMARY	
0305206F	AIRBORNE RECONNAISSANCE SYSTEMS	<p>In FY13, Project 674819, Common Data Link, efforts transferred to PE 0305236F, Project 674819, Common Data Link, in order to provide greater visibility into this congressionally mandated capability and prepare for extended applications as new operational concepts come into existence.</p> <p>In FY13, Project 676031, Dismount Detection Radar (DDR) efforts were transferred from Project 674818, Imaging and Targeting Support in order to provide greater visibility into development activities.</p>
0305208F	DISTRIBUTED COMMON GRND SYS	<p>In FY 2013, Distributed Common Ground System (DCGS) Integrated Backbone (DIB) transferred to PE 0305240F, "Support to Distributed Common Ground System (DCGS) Enterprise", in order to improve visibility into this effort. AF is lead service under the auspices of USD(I).</p> <p>In FY 2013, DCGS-Imagery (DCGS-I) Testbed transferred to PE 0305240F, "Support to Distributed Common Ground System (DCGS) Enterprise", in order to improve visibility into this effort. AF is lead service under the auspices of USD(I).</p> <p>In FY 2013, DCGS Enterprise transferred to PE 0305240F, "Support to Distributed Common Ground System (DCGS) Enterprise", in order to improve visibility into this effort. AF is lead service under the auspices of USD(I).</p> <p>In FY 2013, Common Imagery Processor (CIP) transferred to PE 0305240F, "Support to Distributed Common Ground System (DCGS) Enterprise", in order to improve visibility into this effort. AF is lead service under the auspices of USD(I).</p>
0305220F	RQ-4 UAV	<p>In FY13, Project 676001, NATO AGS, efforts transferred to PE 0305238F, NATO AGS, Project 676001, NATO AGS, in order to manage NATO AGS as a separate program.</p>
0305236F	COMMON DATA LINK (CDL)	<p>In FY13, this is a new PE. In FY 2013, Project 674819, Common Data Link, efforts transfer from PE 0305206F, Airborne Reconnaissance, Project 674819, Common Data Link, in order to provide better visibility for this congressionally mandated capability and prepare for expanded applications as new operational concepts come into existence.</p>
0305238F	NATO AGS	<p>In FY13, Project 676001, NATO AGS, efforts will transfer from PE 0305220F, NATO AGS, Project 676001, NATO AGS to PE 0305238F, NATO AGS, Project 676001, NATO AGS, in order to manage NATO AGS as a separate program.</p>

PROGRAM ELEMENT (BY BUDGET ACTIVITY)	PROGRAM ELEMENT COMPARISON SUMMARY	
0305240F	SUPPORT TO DCGS ENTERPRISE	<p>In FY13, Distributed Common Ground System (DCGS) Integrated Backbone (DIB) transferred from PE 0305208F, Distributed Common Ground System (DCGS), in order to improve visibility into this effort. AF is lead service under the auspice of USD(I).</p> <p>In FY13, DCGS-Imagery (DCGS-I) Testbed transferred from PE 0305208F, DCGS, in order to improve visibility into this effort. AF is lead service under the auspice of USD(I).</p> <p>In FY13, DCGS Enterprise transferred from PE 0305208F, DCGS, in order to improve visibility into this effort. AF is lead service under the auspice of USD(I).</p> <p>In FY13, Common Imagery Processor (CIP) transferred from PE 0305208F, DCGS, in order to improve visibility into this effort. AF is lead service under the auspice of USD(I).</p>
0305881F	RAPID CYBER ACQUISITION	<p>In FY13, this is a new PE. In FY2013, 670374, Electronic Combat Spt, C3 Protection/Multi-Mission, Technology and Spt includes new start efforts.</p>
0307141F	INFO OPS TECH INTEGRATION & TOOL DEV	<p>In FY13, 674871, Information Operations Technology, efforts transferred to PE 0208059F, CYBERCOM Activities, 676002, Cyber Systems Modernization, in order to align all CYBERCOM funding into one PE.</p>
0401115F	C-130 AIRLIFT SQUADRONS	<p>In FY13, project 675244, C-130 CNS/ATM includes new start efforts.</p> <p>In FY13, project 674885, C-130 Avionics Modernization Program was terminated.</p>
0603423F	GPS III - OPER CONTROL SEGMENT	<p>In FY13, funds for GPS Enterprise level engineering integrations efforts were transferred to project 67A025 within this Program Element (PE).</p>
0604263F	COMMON VERTICAL LIFT SUPPORT PLATFORM	<p>In FY13, Project 675277, CVLSP, was terminated.</p>

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	336.021	364.328	361.787	-	361.787	374.267	388.204	395.784	399.208	Continuing	Continuing
612301: <i>Physics</i>	47.953	-	-	-	-	-	-	-	-	Continuing	Continuing
612302: <i>Solid Mechanics and Structures</i>	19.649	-	-	-	-	-	-	-	-	Continuing	Continuing
612303: <i>Chemistry</i>	40.086	-	-	-	-	-	-	-	-	Continuing	Continuing
612304: <i>Mathematical and Computer Sciences</i>	35.945	-	-	-	-	-	-	-	-	Continuing	Continuing
612305: <i>Electronics</i>	42.865	-	-	-	-	-	-	-	-	Continuing	Continuing
612306: <i>Materials</i>	30.681	-	-	-	-	-	-	-	-	Continuing	Continuing
612307: <i>Fluid Mechanics</i>	25.579	-	-	-	-	-	-	-	-	Continuing	Continuing
612308: <i>Propulsion</i>	33.329	-	-	-	-	-	-	-	-	Continuing	Continuing
612311: <i>Information Sciences</i>	50.657	-	-	-	-	-	-	-	-	Continuing	Continuing
613001: <i>Physics and Electronics</i>	-	110.120	112.422	-	112.422	116.344	120.753	123.101	124.107	Continuing	Continuing
613002: <i>Aerospace, Chemical and Material Sciences</i>	-	139.475	108.982	-	108.982	112.743	116.983	119.243	120.216	Continuing	Continuing
613003: <i>Mathematics, Information and Life Sciences</i>	-	104.313	119.236	-	119.236	123.395	128.074	130.565	131.630	Continuing	Continuing
613004: <i>Education and Outreach</i>	-	10.420	21.147	-	21.147	21.785	22.394	22.875	23.255	Continuing	Continuing
614113: <i>External Research Programs Interface</i>	9.277	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, nine legacy Projects 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308 and 2311 were consolidated into three new Projects 3001, 3002, 3003 to more appropriately describe and align the changing focus of the scientific disciplines within the overall Basic Research Program. Also in FY 2012, External Research Programs - Project 4113 was renamed Education and Outreach- Project 3004 to more appropriately describe its mission.

**A. Mission Description and Budget Item Justification**

This program consists of extramural research activities in academia and industry along with in-house investigations performed in the Air Force Research Laboratory. This program funds fundamental broad-based scientific and engineering research in areas critical to Air Force weapon systems. All research areas are subject to long-

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>
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range planning and technical review by both Air Force and tri-Service scientific planning groups. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	350.978	364.328	379.046	-	379.046
Current President's Budget	336.021	364.328	361.787	-	361.787
Total Adjustments	-14.957	-	-17.259	-	-17.259
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-8.494	-			
• SBIR/STTR Transfer	-4.397	-			
• Other Adjustments	-2.066	-	-17.259	-	-17.259

**Change Summary Explanation**

FY11: Other Adjustments include: -2.066 (Congressional General Reductions)

Decrease in FY 2013 due to higher Department of Defense priorities.



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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612301: <i>Physics</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
612301: <i>Physics</i>	47.953	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3001 in this Program Element to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Physics basic research seeks to enable revolutionary advances in, and expand the fundamental knowledge supporting laser technologies, sensing and imaging capabilities, communications and navigational systems, fuels and explosives, and directed energy weapons that are critical to the Air Force. The primary areas of research investigated by this Project are laser and optical physics; electro-energetics (includes plasma) physics; atomic, molecular, and particle physics; space sensors and imaging physics; space environment physics; electronics; and physical mathematics and applied analysis.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Investigate regulated, broad-spectrum, variable-energy lasers, laser arrays, and novel bright incoherent light sources.</p> <p><b>FY 2011 Accomplishments:</b> Extended studies on infrared semiconductor diode lasers to increase available power, efficiency, and wavelength range, at various temperatures. Studied efficient nonlinear optical techniques capable of efficiently converting the wavelength of existing lasers to mid- and long-wave infrared, while capable of handling very high average power.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	11.026	-	-	-	-
<p><b>Title:</b> Major Thrust 2.</p>	14.240	-	-	-	-

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612301: <i>Physics</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Explore high-energy, electro-energetic device concepts and manipulation of atomic and molecular properties, atomic collision processes.</p> <p><b>FY 2011 Accomplishments:</b> Continued to explore frequency comb techniques and ultracold atoms and molecules for precision measurement applications. Explored techniques in micro- and nano-fabrication that better lend themselves to affordable, high-volume fabrication of ultra-high-frequency, compact high-power electromagnetic radiation sources. Continued examination of materials science innovations that promise to advance the state-of-the-art in low work-function field-emission (cold) high current density cathodes. Continued innovations in 3-D modeling of high power microwave (HPM) sources with emphasis on speeding execution times.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Advance technologies for space sensors, imaging, identification and tracking methods, and effective space situational awareness.</p> <p><b>FY 2011 Accomplishments:</b> Continued to develop new sensing modalities that reduce limits on optical resolution and precision tracking of space objects. Investigated new methods of uniquely identifying unresolved space objects and incorporated this investigation in the identification of uncorrelated space objects. Continued study of the physics of signatures in the scattering and reflection of light during active imaging. Expanded research into fundamental processes and energy sources affecting satellite drag leading to improved understanding of precursors to atmospheric density variations.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b></p>	6.010	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>		<b>PROJECT</b> 612301: <i>Physics</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Research space environment to improve solar plasma theories and modeling in the areas of solar phenomena, space weather, magneto/ionosphere effects, and adaptive optics.					
<b>FY 2011 Accomplishments:</b> Investigated proxy indicators of ionospheric and atmospheric processes that could be sensed using inexpensive but effective techniques. Investigated methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere as well as in the solar atmosphere and solar wind. Continued the study of energy flow between solar and terrestrial environments. Continued to study plasma instabilities and plasma processes in the equatorial and polar ionospheres.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 5.					
<b>Description:</b> Research physical mathematics and applied analysis to develop accurate models of physical phenomena to enhance the fidelity of simulation. Conduct research in electromagnetics.					
<b>FY 2011 Accomplishments:</b> Increased basic research support for designing small, highly directive sources which can provide both secure communication and sophisticated waveforms which optimally propagate through various dispersive media. These sources included semiconductor lasers which are optically pumped and, in addition, might be combined to form partially coherent beams which are predicted to be less disturbed by atmospheric turbulence than					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	6.271	-	-	-	-
	10.406	-	-	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
are standard fully coherent laser beams. Continued support of circuit upset research with emphasis on digital circuits.  <b>FY 2012 Plans:</b> N/A  <b>FY 2013 Base Plans:</b> N/A  <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	47.953	-	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612302: <i>Solid Mechanics and Structures</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
612302: <i>Solid Mechanics and Structures</i>	19.649	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3002 in this Program Element to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Solid mechanics and structures basic research aims to improve load-bearing performance of air and space structures through the prediction and control of multi-scale phenomena ranging from micro-level deformation and fracture of materials to the structural dynamics of large platforms. The goals are cost-effective development and safe, reliable operation of superior Air Force weapon and defensive systems. Fundamental knowledge of "multi functional" structures with smart materials, sensors, actuators, and control systems integrated to accomplish damage control, thermal management, vibration reduction, and reconfigurable shapes. Research topics include: the modeling of non-linear static/dynamic behavior of structures; mechanical reliability of micro-devices; design of multi-functional materials; mechanical behavior of nanomaterials; and composite materials for structures.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Explore the integration of advanced materials, nano-materials, and devices into turbine engines, air vehicles, space systems, and other weapon systems.

**FY 2011 Accomplishments:**

Expanded research in the area of multifunctional materials and microsystems for autonomic sensing and self-diagnosis of exogenous threats. Continued research in the area of multifunctional materials and microsystems for reconfigurable structures allowing shape change and property tuning. Continued research in the areas of prognostics, autonomics, self-healing, thermal management, energy harvesting/storage, electromagnetic energy radiation/transmission, and micro-/nano-mechanics to enable safer and more durable aerospace structures with improved performance characteristics. Further developed the fundamental knowledge required to design and manufacture multi-functional aerospace material systems and devices and to predict their performance and structural integrity.

**FY 2012 Plans:**

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
9.413	-	-	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.  <b>Description:</b> Analyze structural fatigue and mechanics, adaptive structures, and material properties to improve the design, robustness, and performance of air and space systems.  <b>FY 2011 Accomplishments:</b> Continued to seek new and revolutionary flight structure concepts that will permit broader operational capabilities, a faster reconfigurable ability, and more affordable accelerated fabrication. Investigated new structures of novel materials developed under the advanced materials programs. Expanded the understanding of structural health monitoring sensors and techniques, and tested the developed new science under laboratory conditions. Enhanced the understanding of dynamic and mechanical behavior of flight structures under extreme environments such as intense vibration, nonlinear structural dynamics, unsteady aero-thermo-elastic effects, and directed energy effects to increase operational survivability and mission success.  <b>FY 2012 Plans:</b> N/A  <b>FY 2013 Base Plans:</b> N/A	10.236	-	-	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	19.649	-	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>										
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612302: <i>Solid Mechanics and Structures</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 612303: <i>Chemistry</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
612303: <i>Chemistry</i>	40.086	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3002 in this Program Element to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Chemistry basic research seeks bold innovations in understanding, modeling, and controlling chemical reactions for developing new materials, improving synthesis of existing materials, controlling energy flow and storage, and regulating interactions between materials and their environments. Studies expand fundamental understanding of properties regulating the chemical dynamics and energy transfer processes that foster advances in laser weaponry and allow predictions of the infrared, optical, and radar signatures of reaction products and intermediates that advance reliable target assessment and tracking. Critical research topics include: novel synthesis and characterization of lower cost, higher performance functional and structural materials, electronics, and photonic materials; nanostructures; electromagnetics; and conventional weaponry. Focused investigations include bio-derived mechanisms for lifetime extension of materials and catalysis and the exploration of atomic and molecular surface interactions that limit performance of electronic devices, compact power sources, and lubricant materials. Primary areas of research include molecular reaction dynamics, theoretical chemistry, polymer chemistry, biophysical mechanisms, and surface and interfacial science.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Research and characterize molecular dynamics, reaction mechanics/interactions, and theoretical chemistry to model, predict, control, and exploit atomic and molecular energetics.</p> <p><b>FY 2011 Accomplishments:</b> Studied a fundamental understanding of basic chemical and physical processes on the nanoscale. Developed methods that can describe material behavior from the atomic level through mesoscopic and macroscopic scales and simulated chemical processes to model bulk scale properties. Developed theoretical methods to predict energy and density of novel energetic materials. Explored methods to use catalysis to improve energy utilization and storage. Created new selective and sensitive sensors for detecting trace species. Performed experiments and simulations to understand chemical processes in space for situational awareness. Investigated processes needed to assess scalability of hybrid laser concepts.</p> <p><b>FY 2012 Plans:</b></p>	16.985	-	-	-	-



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612303: <i>Chemistry</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A <b>FY 2013 Base Plans:</b> N/A <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2. <b>Description:</b> Enhance fundamental understanding of polymer chemical structures, reactivity, molecular engineering, processing controls, and materials technologies. <b>FY 2011 Accomplishments:</b> Explored organic transistors with flexibility, mechanical robustness and higher performance or equivalent of a-Si transistors. Explored rewritable color 3-D hologram displays using photorefractive polymers. Assessed feasibility of controlling chirality of molecular structures to achieve negative index behavior in the optical or infrared range. <b>FY 2012 Plans:</b> N/A <b>FY 2013 Base Plans:</b> N/A <b>FY 2013 OCO Plans:</b> N/A	13.010	-	-	-	-
<b>Title:</b> Major Thrust 3. <b>Description:</b> Characterize, model, and exploit the fundamental chemistry and physics that govern surface and interfacial degradation from completely frictionless to total deterioration. <b>FY 2011 Accomplishments:</b> Applied knowledge of chemical and morphological effects on degradation of simple surfaces towards development of theoretical and predictive models for degradation of complex and hybrid surfaces and materials across multiple length scales. Investigated fundamental chemistry and physics of surface wear driving towards	10.091	-	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612303: <i>Chemistry</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
a comprehensive understanding of the role of the chemical environment. Developed real-time nano-tribological instrumentation capable of in-situ friction, adhesion, and wear experimentation.  <b>FY 2012 Plans:</b> N/A  <b>FY 2013 Base Plans:</b> N/A  <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	40.086	-	-	-	-

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612304: <i>Mathematical and Computer Sciences</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
612304: <i>Mathematical and Computer Sciences</i>	35.945	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3003 in this Program Element to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Mathematics and computing sciences basic research develops novel techniques for mathematical modeling and simulation, algorithm development, complex systems control, and innovative analytical and high performance computing methods for air and space systems. Basic research provides fundamental knowledge enabling improved performance and control of systems and subsystems through accurate models and computational tools, artificial intelligence, and improved programming techniques and theories. The primary areas of research investigated by this Project are dynamics and control, optimization and discrete mathematics, and computational mathematics.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Perform dynamics and control research to develop innovative techniques for design and analysis of complex control systems.

**FY 2011 Accomplishments:**

Further developed heterogeneous and mixed human-robot interaction concepts for the design and analysis of cooperative control systems in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, remotely piloted aircraft (RPAs), and constellations of small satellites. Developed increased levels of high-confidence adaptive control and machine learning techniques for teams of micro air vehicles operating at various altitudes in complex environments to execute assigned missions with variable operator intervention. Continued development of control methodologies to improve non-equilibrium behavior of complex, nonlinear systems. Advanced image processing and sensor technologies for use in cooperative teams of RPAs and smart munitions to include multiple target tracking, ownship and world state estimation. Continued development of mathematical control theoretic models that capture the robust, nonlinear, hybrid dynamics of microbiological systems. Further developed methods for design and analysis of bio-inspired sensing systems, controls, and computational systems. Continued development of algorithms for control of and over dynamic,

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
18.286	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612304: <i>Mathematical and Computer Sciences</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>large-scale networks. Continued development of theory and algorithms for specification, design, verification, and validation of distributed embedded control systems.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Conduct research in optimization, as well as computational and discrete mathematics, to validate and further advance mathematical methods, algorithms, and modeling and simulation.</p> <p><b>FY 2011 Accomplishments:</b> Continued developing mathematically rigorous numerical algorithms for enhancing the modeling and simulations of large, complex, multi-scale, and nonlinear systems and phenomena of interest to the Air Force. The application areas in plasma, aerodynamics, structural mechanics, and materials emphasized the increasing challenges in capturing the unsteady, dynamic, multi-physics, and multi-scale nature of the problems. Supported development and integration of novel optimization strategies with high order, time-accurate solutions for superior design of Air Force systems.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	17.659	-	-	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	35.945	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612304: <i>Mathematical and Computer Sciences</i>

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 612305: <i>Electronics</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
612305: <i>Electronics</i>	42.865	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3001 in this Program Element to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Electronics basic research generates and exploits fundamental knowledge and understanding of novel solid-state electronic, sensor, and optoelectronic materials and device implementation schemes vital to advance Air Force operational capabilities in surveillance, information and signal processing, communications, command and control, electronic countermeasures, stealth technologies, and directed energy weapons. Solid state electronics research discovers and develops new materials, advances processing and fabrication sciences, and develops and implements advanced physical modeling and simulation capabilities essential to evaluate novel electronic, sensor, and optoelectronic structures and device concept implementation schemes. Research stresses high-risk, far-term, game changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Investigate novel detector and electronic materials, device concepts, and circuit architecture and implementation schemes important to future military space platforms.

**FY 2011 Accomplishments:**

Continued investigating novel multi-modal electromagnetic spectra detection approaches and concepts utilizing increased understanding of phenomenological interactions between target/background radiation and novel nanomaterials, structures, and devices. Specific emphasis was placed on achieving material structures yielding linearly-graded semiconductor bandgap behavior or capable of dynamic bandgap tuning over the range ~ 0.2 - 2.5eV. In addition, novel materials and/or device structures capable of dynamic absorption coefficient tuning were studied, along with concepts for thin-film spectra-filter tuning. Continued emphasis was placed on physics controlling semiconductor hetero-interface band misalignments that critically control carrier transport properties.

**FY 2012 Plans:**

N/A

**FY 2013 Base Plans:**

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
10.438	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>		<b>PROJECT</b> 612305: <i>Electronics</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Investigate quantum and optoelectronic materials/devices, memory, information processing, and nanoscience for wide-field spectral sensors and critical, high-speed communication.					
<b>FY 2011 Accomplishments:</b> Continued efforts to better determine the optimal implementation of multi-ferroic materials for a wide variety of technologically advanced applications for the warfighter. Continued to explore the suitability of spintronic device elements that can be integrated into high performance, ultra-miniature logic and control systems. Explored special semiconducting and electronic materials that enable all photonic signal processing and logic technology, and began to explore integration of these advanced technologies with radio frequency (RF) micro electro-mechanical systems concepts. Explored wide band gap semiconductors for high performance, high power RF applications with an in-depth understanding of device reliability issues. Continued research on special materials and nanostructures that will permit an expansion of device functionality beyond the current limits on silicon technology.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Exploit advances in nanotechnology to support multi-spectral detection technology, chip-scale optical networks, and compact power.					
<b>FY 2011 Accomplishments:</b> Pursued research in light localization below the wavelength scale, using concepts of plasmon optics, photonic crystal, and metamaterial nanophotonics for ultra-compact integrated photonic systems, ultra-compact optically					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	16.416	-	-	-	-
	7.777	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>		<b>PROJECT</b> 612305: <i>Electronics</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
functional devices, light-harvesting elements for molecular and nanocrystalline-based photovoltaic devices, lithographic patterning at deep sub-wavelength dimensions, and aberration-free lenses that enable optical imaging with unprecedented resolution. Continued to exploit silicon-compatible components for photonics and take advantage of the mature processing and manufacturing expertise that silicon technology affords. Pursued smaller and more highly integrated optical subsystems for telecommunications applications and high speed processing. Explored thermoelectric applications of silicon and germanium based nanomembranes made into nanowires and nanoribbons plus nanowire photovoltaic devices. Enhanced solar-energy conversion through plasmon enhanced photovoltaic films, and investigated the feasibilities of nitride based and non-traditional material nanostructures for applications in photoelectrochemical cell technology, and thermoelectric device technology.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Investigate quantum electronic solids phenomena to explore superconducting, magnetic, negative index, and nanoscopic materials.					
<b>FY 2011 Accomplishments:</b> Utilized implanted defect structures in diamond films to produce a system of addressable electron spin states that can be manipulated and entangled so that concepts in quantum information science may be tested at room temperature. Investigated nanoelectronic elements utilizing carbon nanotubes to form the basis for a new generation of sensors and circuit elements. Continued metamaterials research in coordination with Air Force laboratories to produce more efficient and smaller, omni-directional antennas. Continued search for new classes of superconductors to begin to produce several new superconducting materials that will be much more cost effective.					
<b>FY 2012 Plans:</b>					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	8.234	-	-	-	-



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612305: <i>Electronics</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>FY 2013 Base Plans:</b>					
N/A					
<b>FY 2013 OCO Plans:</b>					
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	42.865	-	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force									<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 612306: <i>Materials</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
612306: <i>Materials</i>	30.681	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3002 in this Program Element (except the natural systems and extremophiles major thrust efforts moved to Project 3003) to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Materials basic research enhances the performance, cost, and reliability of structural materials to eliminate reliability issues related to high-temperature strength, toughness, fatigue, and environmental conditions. This research expands fundamental knowledge of material properties that leads to the development of novel materials for airframe, turbine engine, and spacecraft structures. The goals of this Project are to develop improved materials for air and space vehicles that provide increased structural efficiency and reliability, increase the operating temperature of aerospace materials, and further increase thrust-to-weight ratio of engines. A primary research focus is on refractory alloys, intermetallics, polymer composites, metal and ceramic matrix composites, advanced ceramics, and new material processing methods. Basic research is also conducted in natural materials and systems to exploit unique properties and products for use in the development of advanced weapon technologies. Research is conducted to mimic the natural detection systems of organisms at the molecular level for use in developing novel manmade sensors. Research in natural materials focuses on using existing organisms or bioengineered organisms to manufacture new materials, or using the organisms themselves as materials. The primary areas investigated by this Project are ceramics, non-metallic hybrid composites, metallic materials, and natural materials and systems.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Perform non-metallic, ceramic, and hybrid materials research to identify/design new materials and composites with very-high (above 1400 degrees Fahrenheit) and ultra-high (above 2500 degrees Fahrenheit) temperatures.

**FY 2011 Accomplishments:**

Investigated the impact of incorporation of carbon nanotubes in carbon fibers. Studied the incorporation of nano-particle incorporation in thermoplastic composites to improve its crystallization rate in filament winding conditions. Investigated the influence of nanoparticle networks within amorphous materials on high temperature mechanical properties. Continued modeling of interfacial properties between matrix and fiber in fiber reinforced composites.

**FY 2012 Plans:**

<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
12.419	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612306: <i>Materials</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A <b>FY 2013 Base Plans:</b> N/A <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2. <b>Description:</b> Perform research in metallic, ceramic and hybrid materials to understand their properties at temperatures above 1000 degrees Celsius. <b>FY 2011 Accomplishments:</b> Continued optimizing the thermal and mechanical stability of high temperature aerospace materials for air and space applications. Exploited new approaches to designing hybrid high temperature materials to enhance performance in harsh thermal environments. Further examined innovative concepts for developing stronger and more damage-tolerant high temperature hybrid materials. Further explored opportunities to reduce system weight and/or size, increased operational lifetime, and high temperature performance of aerospace structures. <b>FY 2012 Plans:</b> N/A <b>FY 2013 Base Plans:</b> N/A <b>FY 2013 OCO Plans:</b> N/A	13.326	-	-	-	-
<b>Title:</b> Major Thrust 3. <b>Description:</b> Explore mimetics, natural materials, and natural/synthetic interfaces to enable development of novel sensors, engineering processes, and mechanisms. <b>FY 2011 Accomplishments:</b> Continued to manipulate materials to mimic the desirable properties found in autonomous materials for maintenance, self-healing, and repair. Continued to probe and manipulate chromophores and photoluminescent	4.936	-	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612306: <i>Materials</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
characteristics in natural systems for applications to military sensor systems. Expanded the research of natural materials' extension into new electronic and photonic systems by utilizing the self-assembly of these materials into unique electronic and optical architectures for ISR applications.					
<b><i>FY 2012 Plans:</i></b> N/A					
<b><i>FY 2013 Base Plans:</i></b> N/A					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	30.681	-	-	-	-

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force									<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 612307: <i>Fluid Mechanics</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
612307: <i>Fluid Mechanics</i>	25.579	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3002 in this Program Element (exception: the sensory information systems major thrust efforts moved to Project 3003) to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Fluid mechanics basic research advances fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of air and space vehicles. The goals are to improve theoretical models for aerodynamic prediction and design, as well as to originate flow control concepts and predictive methods used to expand current flight performance boundaries through enhanced understanding of key fluid flow (primarily high-speed air) phenomena. Vehicle control principles based upon natural flight sensory and sensorimotor systems applicable to small remotely piloted aircraft (RPAs) and ultraslow flight are also examined. Basic research emphasis is on turbulence prediction and control, unsteady and separated flows, subsonic/supersonic/hypersonic flows, and internal fluid dynamics. The primary approach is to perform fundamental experimental investigations and to formulate advanced computational methods for the simulation and study of complex flows, prediction of real gas effects in high-speed flight, and control and prediction of turbulence in flight vehicles and propulsion systems. Primary areas of research investigated by this Project are unsteady aerodynamics, supersonic and hypersonic aerodynamics, turbulence, and rotating and internal flows characteristic of turbomachinery flows.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Investigate and characterize complex phenomena in supersonic, hypersonic, boundary layers, and turbulent flows to enable and optimize the design of air and space vehicles systems.

**FY 2011 Accomplishments:**

Characterized and modeled fundamental phenomena of high-speed boundary layers, including interactions between multiple instability modes in laminar-turbulent transition and the influence of realistic surface conditions including roughness, ablation and surface chemistry. Continued validation of high-fidelity, unsteady numerical simulation methodologies for shock-dominated flows, including non-equilibrium effects and laminar-turbulent transition and implementation of potential control methods via simulation of benchmark canonical problems. Refined strategies for control of excessive heat transfer, unsteadiness, and separation in hypersonic flows to reduce severe local loads on systems. Developed multidisciplinary simulation capability for prediction of

<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
8.940	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
interactions between severe phenomena in aerothermodynamic environment and high-temperature vehicle materials with the goal of reducing thermal protection system complexity and increasing system performance.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Expand fundamental knowledge of unsteady flows in integrated theoretical, experimental, and computational efforts. Study complex flow phenomena related to unsteady phenomena.					
<b>FY 2011 Accomplishments:</b> Developed physically accurate descriptions of unsteady flows over complex geometries and highly flexible structures. Derived and assessed reduced order models of canonical flow problems that lead to robust, closed loop flow control approaches. Refined modeling of promising flow control techniques to optimize fluid-structure interactions and aerodynamic efficiency for a wider range of flight operating conditions. Continue validation of tools for predicting and controlling unsteady, vortex-dominated flows on RPAs in a range of scales. Developed numerical tools for multidisciplinary simulation of unsteady fluid-structure interactions.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Research novel sensing and control mechanisms applicable to small RPAs and low Reynolds Number flight regimes. Expand fundamental knowledge of natural flight control and navigation.					
	9.881	-	-	-	-
	6.758	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Investigated natural flight capabilities applicable to multiple, coordinated air vehicles operating in cluttered and/or unpredictable environments. Developed mathematical approaches for intelligent, autonomous flight control and navigation in multi-vehicle arrays and cooperative swarms, based upon natural systems of sensing and guidance, with emphasis on possible applications to small RPAs operating in low Reynolds Number regimes. Continued to develop mathematical and neuromorphic algorithms based upon sensorimotor information processing to enable new capabilities in autonomous flight.</p> <p><b><i>FY 2012 Plans:</i></b> N/A</p> <p><b><i>FY 2013 Base Plans:</i></b> N/A</p> <p><b><i>FY 2013 OCO Plans:</i></b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	25.579	-	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>												
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612308: <i>Propulsion</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
612308: <i>Propulsion</i>	33.329	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**  
Note: In FY 2012, all efforts were moved from this Project to Project 3002 in this Program Element (exception: the bioenergy major thrust efforts moved to Project 3003) to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Propulsion basic research expounds fundamental knowledge to enable and enhance efficient utilization of energy in airbreathing engines, chemical and non-chemical rockets, and combined cycle propulsion systems for future rapid global reach and on-demand space access. Basic research thrusts include airbreathing propulsion, space power and propulsion, high altitude signature characterization and contamination, propulsion diagnostics, thermal management of space-based power and propulsion, and the synthesis of new chemical propellants. These thrusts can be grouped into reacting flows and non-chemical energetics. Study of reacting flows involves the complex coupling between energy release through chemical reaction and the flow processes that transport chemical reactants, products, and energy. Non-chemical energetics research includes both plasma and beamed-energy propulsion for orbit-raising space missions and ultra-high energy techniques for spacebased energy utilization. Primary areas of research investigated by this Project are space power, propulsion, combustion, and diagnostics. As a newly emerging research direction within this Project, bioenergy and catalysis will investigate the economical production of renewable biofuels for airbreathing engines and will explore biocatalysis for compact power applications.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Research and model space propulsion and power in the areas of chemistry, electronics, miniaturization, and contamination/signature.</p> <p><b>FY 2011 Accomplishments:</b> Continued the study of novel energetic propellants for space propulsion, including nano-aluminum, ammonium borane, silicon, and hydrogen peroxide to achieve cryogenic propellant performance with non-cryogenic propellants in both launch and in-space systems. Continued investigation of nano-energetics in liquid and gel propellants to increase specific impulse in liquid propulsion systems, and studied the dynamic behavior of such systems, including three-phase, high-pressure, and temperature combustion phenomena. Continued investigating alternate launch systems using electromagnetic forces and beamed energy. Investigated new electric propulsion concepts for nano, micro, and macro satellites, including electrodeless and propellantless</p>	12.246	-	-	-	-



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>		<b>PROJECT</b> 612308: <i>Propulsion</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
systems, and power regeneration through thermoelectric materials. Conducted research on near-space propulsion alternatives, including air-breathing plasma propulsion systems.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Explore combustion, propulsion, and diagnostics in subsonics, supersonics, and hypersonics. Investigate multi-phase, turbulent reacting flows.					
<b>FY 2011 Accomplishments:</b> Continued improving laser diagnostic measurement capabilities, investigations of molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions, and prediction methodologies, which are both quantitatively accurate and computationally tractable, for turbulent combustion models. Continued research on the coupling between plasma chemistry and fuel combustion chemistry to understand ignition and combustion enhancement by plasmas. Continued exploitation of strategies for using alternate hydrocarbon fuels by inserting reduced fuel representations into comprehensive combustion models such as large eddy simulations. In support of the Energy Conservation-Assured Fuels Initiative, continued studies of novel propulsion system design based on alternative fuel properties to achieve optimization with respect to performance, environmental impact, cost, and assured supply.					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
	14.218	-	-	-	-
	6.865	-	-	-	-

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Identify, characterize, and bioengineer photosynthetic and/or non-photosynthetic microorganisms and their metabolic pathways.</p> <p><b>FY 2011 Accomplishments:</b> Continued to study biosolar hydrogen research to redirect the photosynthetic flow of electrons to the hydrogen-generating enzyme by eliminating and/or adding genes that code for alternative pathways of electron flow and for the oxygen-sensitive inhibition of the hydrogen-generating enzyme. Expanded bio-prospecting research to identify and clone unique algal oil-generating genes that metabolically engineer into one strain, optimizing the control and enhancement of algal oil for use as a future source of jet fuel. Continued research on microbial fuel cells that may potentially enhance power generation by exploring and characterizing newly discovered bacterial nanowires to understand their role in transporting electrons from microbial biofilms to electrodes.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	33.329	-	-	-	-

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 612311: <i>Information Sciences</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
612311: <i>Information Sciences</i>	50.657	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts were moved from this Project to Project 3003 in this Program Element (exception: the sensing, surveillance, and navigation major thrust efforts moved to Project 3001) to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

**A. Mission Description and Budget Item Justification**

Information sciences basic research generates fundamental knowledge and understanding to support critical Air Force capabilities in information superiority, precision targeting (or strike), and improved battle space awareness. Areas of research focus are (1) access to disparate data and information, (2) information fusion and distribution, and (3) conversion of information into knowledge to support decision making. The data, fusion engines, and command and control functions reside on interlocking systems connected by networks leading to a system of systems architecture. Areas of research underpinning these team-focused, network-enabled systems are those in networks and communications, software, information management, and human-system interactions. Complementing these overall focus areas, research is occurring in the following areas: information operations network, software, and system architectures; information fusion; information forensics; communications and signals and control of large systems. Information Sciences also derive mathematical models and computational algorithms designed to optimize information intelligently and problem-solving under adverse conditions, including sustained operations, non-cooperative environments, and multi-interactive command and control.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<b>Title:</b> Major Thrust 1.	11.351	-	-	-	-
<b>Description:</b> Conduct fundamental research in signals analysis for enhancement of sensing, surveillance, and targeting capabilities, increased awareness, and improved reaction/response.					
<b>FY 2011 Accomplishments:</b> Conducted research in innovative sensing and multi-modal data acquisition, and explored the ways and means for integration of electro-optical, radar, ladar, and inertial systems with global positioning satellite (GPS) in electromagnetically and physically challenged environments. Explored scientific issues connected with radar imaging (and target identification) including the determination of advantageous classes of transmit waveforms, for bistatic, multiple-output, or some other distributed set-up, together with the needed conceptual mathematics and computational techniques. Explored covertness and encryption requirements in "free-space" communication					

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>including problems of information theory/optics whose solutions provide new methods of sequence key encryption.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Conduct research in complex systems and algorithms for highly flexible, reliable, secure, and rich information systems supporting battlefield commanders.</p> <p><b>FY 2011 Accomplishments:</b> Increased emphasis on developing a science of cyber security. Developed new software systems modeling techniques that incorporate human behavioral models into software architectures to capture fundamental human-computer interaction. Initiated information operations research on artificial diversity. Expanded research on how fundamental mathematical methods translate into improved reliability and security of existing and future networks. Continued developing fundamental science of information integration and fusion that provides for situation and impact assessment to achieve predictive response.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	26.789	-	-	-	-
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Evaluate fundamental mechanisms and build mathematical descriptions of cognitive decisionmaking, including adaptation to non-cooperative interactions.</p>	12.517	-	-	-	-

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b><i>FY 2011 Accomplishments:</i></b> Continued to investigate high-order cognitive processes, and explore new mathematical frameworks to enable, in a principled way, upward scaling of cognitive information processing approaches from simpler to more complex and realistic decision-making tasks. Developed and tested algorithms for applications in reinforcement learning, sequential sampling, kernel-based classification and generalization, Bayesian forecasting, and optimization of attentional resources. Developed new techniques to understand, measure, and control informational masking to enhance speech communication and situational awareness. Investigated the fundamental constraints and limits of computationally-based socio-cultural prediction, including scalability from individual or small groups to larger coalitions.</p> <p><b><i>FY 2012 Plans:</i></b> N/A</p> <p><b><i>FY 2013 Base Plans:</i></b> N/A</p> <p><b><i>FY 2013 OCO Plans:</i></b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	50.657	-	-	-	-

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
613001: <i>Physics and Electronics</i>	-	110.120	112.422	-	112.422	116.344	120.753	123.101	124.107	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts from Projects 2301 and 2305 in this Program Element (PE) as well as the sensing, surveillance, and navigation major thrust effort in Project 2311 in this PE moved to this new Project to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

Note: In FY 2013, traditional laser efforts moved from Thrust 1 to Thrust 3 in this PE to more appropriately align the scientific disciplines.

**A. Mission Description and Budget Item Justification**

Basic research in the Physics and Electronics Project seeks to enable revolutionary advances in, and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major thrust areas being investigated in this Project are complex electronics and fundamental quantum processes; plasma physics and high energy density non-equilibrium processes; and lasers and optics, electromagnetics, communication, and signal processing. Although the major thrust descriptions that follow are specific sub-areas of focus within this Project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other Projects within this PE.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Complex Electronics and Fundamental Quantum Processes: Scientific focus areas are atomic and molecular physics, optical physics, photonics, quantum electronic solids, adaptive multi-mode sensing and ultra-high speed electronics, semiconductor and electromagnetic materials, and optoelectronics.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, di-electric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes research to understand mechanisms of generating and controlling quantum states, such as superposition and entanglement, in photons and ultra-cold atoms and molecules.</p> <p><b>FY 2013 Base Plans:</b></p>	-	64.971	61.429	-	61.429

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, di-electric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultra-cold atoms and molecules.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Plasma Physics and High Energy Density Non-Equilibrium Processes: Scientific focus areas are electro-energetic physics and space sciences.					
<b>FY 2011 Accomplishments:</b> N/A					
<b>FY 2012 Plans:</b> Explore a wide range of activities characterized by processes sufficiently energetic to require the understanding and managing of plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma control of boundary layers in turbulent flow, plasma discharges, radio frequency (RF) propagation, RF-plasma interaction, and high-power, beam-driven microwave devices.					
<b>FY 2013 Base Plans:</b> Explore a wide range of activities characterized by processes sufficiently energetic to require the understanding and managing of plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma control of boundary layers in turbulent flow, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Lasers and Optics, Electromagnetics, Communication and Signal Processing Research: Scientific focus areas are physical mathematics and applied analysis, electromagnetics, remote sensing and imaging physics, and surveillance and navigation.					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	-	14.316	14.615	-	14.615
	-	30.833	36.378	-	36.378

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613001: <i>Physics and Electronics</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b><i>FY 2011 Accomplishments:</i></b> N/A</p> <p><b><i>FY 2012 Plans:</i></b> Explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigate aspects of the phenomenology of lasers including high energy lasers and non-linear optics. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals.</p> <p><b><i>FY 2013 Base Plans:</i></b> Explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigate aspects of the phenomenology of lasers including high energy lasers and non-linear optics. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals.</p> <p><b><i>FY 2013 OCO Plans:</i></b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	-	110.120	112.422	-	112.422

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
613002: <i>Aerospace, Chemical and Material Sciences</i>	-	139.475	108.982	-	108.982	112.743	116.983	119.243	120.216	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts from Projects 2302, 2303, 2306 (except the natural systems and extremophiles major thrust effort, which moved to Project 3003), 2307 (except the sensory information systems major thrust effort, which moved to Project 3003), and 2308 (except the bioenergy major thrust effort, which moved to Project 3003) in this Program Element (PE) moved to this new Project to more appropriately describe and align the changing focus of the scientific disciplines within the overall program.

Note: Decrease in FY 2013 due to higher Department of Defense priorities in Projects 3003 and 3004. The level of effort in each thrust will be reduced.

**A. Mission Description and Budget Item Justification**

Basic research in the Aerospace, Chemical, and Materials Sciences Project seeks to enable revolutionary advances in, and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major thrust areas being investigated in this Project are aero-structure interactions and control; energy, power, and propulsion; and complex materials and structures. Although the major thrust descriptions that follow are specific sub-areas of focus within this Project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other Projects within this PE.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Aero Structure Interactions and Control: Scientific focus areas are high temperature aerospace materials, hypersonics, aerothermodynamics and turbulence, and flow interactions and control.

**FY 2011 Accomplishments:**

N/A

**FY 2012 Plans:**

Investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
-	34.868	27.245	-	27.245

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613002: <i>Aerospace, Chemical and Material Sciences</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, structures, and thermodynamics.</p> <p><b>FY 2013 Base Plans:</b> Investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, structures, and thermodynamics.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Energy, Power, and Propulsion: Scientific focus areas are thermal control, theoretical chemistry, molecular dynamics, space power and propulsion, and combustion and diagnostics.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigate processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Includes developing novel energetic materials as well as understanding and optimizing combustion processes.</p> <p><b>FY 2013 Base Plans:</b> Exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigates processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Includes developing novel energetic materials as well as understanding and optimizing combustion processes.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	-	46.027	35.964	-	35.964
<p><b>Title:</b> Major Thrust 3.</p>	-	58.580	45.773	-	45.773

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Complex Materials and Structures: Scientific focus areas are mechanics of multifunctional materials and microsystems, multi-scale mechanics and prognosis, low density materials, and polymer chemistry.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Investigate multifunctional materials and structures composed of different classes of materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility.</p> <p><b>FY 2013 Base Plans:</b> Investigate multifunctional materials and structures composed of different classes of materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	-	139.475	108.982	-	108.982

<b>C. Other Program Funding Summary (\$ in Millions)</b>										
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000 Continuing Continuing

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613002: <i>Aerospace, Chemical and Material Sciences</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 613003: <i>Mathematics, Information and Life Sciences</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
613003: <i>Mathematics, Information and Life Sciences</i>	-	104.313	119.236	-	119.236	123.395	128.074	130.565	131.630	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts from Projects 2304 and 2311 (except the sensing, surveillance, and navigation major thrust effort, which moved to Project 3001) in this Program Element (PE) moved to this new Project to more appropriately describe and align the changing focus of the scientific disciplines within the overall program. The natural systems and extremophiles major thrust effort in Project 2306, the sensory information systems major thrust effort in Project 2307, and the bioenergy major thrust effort in Project 2308 of this PE also moved to this new Project.

Note: In FY 2013, increased emphasis will be placed on complex networks, software, and decision making.

**A. Mission Description and Budget Item Justification**

Basic research in the Mathematics, Information, and Life Sciences Project seeks to enable revolutionary advances in, and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major thrust areas being investigated in this Project are information and complex networks, decision making, dynamical systems, optimization and control, and natural materials and systems. Although the major thrust descriptions that follow are specific sub-areas of focus within this Project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other Projects within this PE.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<b>Title:</b> Major Thrust 1.	-	29.208	34.386	-	34.386
<b>Description:</b> Information and Complex Networks: Scientific focus areas are systems and software, information operations and security, information fusion, and complex networks.					
<b>FY 2011 Accomplishments:</b> N/A					
<b>FY 2012 Plans:</b> Design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. Includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas					

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613003: <i>Mathematics, Information and Life Sciences</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>include system and network performance prediction, design and analysis, and modeling of human-machine systems.</p> <p><b>FY 2013 Base Plans:</b> Design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. Includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas include system and network performance prediction, design and analysis, and modeling of human-machine systems.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Decision Making: Scientific focus areas are mathematical modeling of cognition and decision making, and collective behavior and socio-cultural modeling.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making.</p> <p><b>FY 2013 Base Plans:</b> Investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	-	14.604	18.693	-	18.693
<p><b>Title:</b> Major Thrust 3.</p>	-	39.638	42.309	-	42.309

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613003: <i>Mathematics, Information and Life Sciences</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Description:</b> Dynamical Systems, Optimization, and Control: Scientific focus areas are computational mathematics, dynamics and control, and optimization and discrete mathematics.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Includes study of novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments.</p> <p><b>FY 2013 Base Plans:</b> Develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Includes study of novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Natural Materials and Systems: Scientific focus areas are renewable energy, natural materials and nature inspired systems.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems</p>	-	20.863	23.848	-	23.848

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613003: <i>Mathematics, Information and Life Sciences</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

and add existing capabilities to these organisms with the intent to gain more precise control over their material production.

***FY 2013 Base Plans:***

Investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production.

***FY 2013 OCO Plans:***

N/A

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Accomplishments/Planned Programs Subtotals</b>				
-	104.313	119.236	-	119.236

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
613004: <i>Education and Outreach</i>	-	10.420	21.147	-	21.147	21.785	22.394	22.875	23.255	Continuing	Continuing

**Note**

Note: In FY 2012, all efforts from Project 4113 in this Program Element moved to this new Project to more appropriately describe and align the changing focus of outreach development within the overall program.

Note: In FY 2013, increased emphasis will be placed on international collaborations, the National Research Council Resident Research Program and the Summer Faculty Research Program.

**A. Mission Description and Budget Item Justification**

The major thrust areas in this Science & Technology (S&T) Outreach Development Project are to facilitate interactions between the international and domestic research communities and Air Force researchers, and to support and develop scientists and engineers with an awareness of Air Force basic research priorities. These professional interactions and collaborations stimulate scientific and engineering education beneficial to the Air Force, increase the awareness of Air Force basic research priorities to the research community as a whole, and attract talented scientists and engineers to address Air Force needs. International interactions facilitate future interoperability of coalition systems and foster relationships with future coalition partners. This Project also seeks to enhance educational interactions with historically black colleges and universities, Hispanic serving institutions, and other minority institutions.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Outreach to International S&T Community: Foster international S&T cooperation by supporting direct interchanges with a broad range of key international researchers and communities. Identify and leverage international scientific advances when appropriate.

**FY 2011 Accomplishments:**

N/A

**FY 2012 Plans:**

Leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
-	5.238	9.935	-	9.935

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613004: <i>Education and Outreach</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Department of Defense (DoD) S&amp;T delegations, and provide primary interface to coordinate international S&amp;T participation among DoD organizations.</p> <p><b>FY 2013 Base Plans:</b> Leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level Department of Defense (DoD) S&amp;T delegations, and provide primary interface to coordinate international S&amp;T participation among DoD organizations.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Outreach to U.S. S&amp;T Workforce: Strengthen science, mathematics, and engineering research and educational infrastructure in the U.S., thereby strengthening current and future Air Force S&amp;T capabilities.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> Increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research, and educational outreach programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions.</p> <p><b>FY 2013 Base Plans:</b> Increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research, and educational outreach programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions.</p> <p><b>FY 2013 OCO Plans:</b></p>	-	5.182	11.212	-	11.212

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 613004: <i>Education and Outreach</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	-	10.420	21.147	-	21.147

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 614113: <i>External Research Programs Interface</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
614113: <i>External Research Programs Interface</i>	9.277	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, as part of the realignment of the overall Program to reflect the changing focus of the scientific disciplines, this Project was renamed Education and Outreach - Project 3004 to more appropriately describe its mission.

**A. Mission Description and Budget Item Justification**

The primary elements in this Project are to facilitate interactions between the international and domestic research communities and Air Force researchers, and to support and develop scientists and engineers with an awareness of Air Force basic research priorities. These professional interactions and collaborations stimulate scientific and engineering education beneficial to the Air Force, increase the awareness of Air Force basic research priorities to the research community as a whole, and attract talented scientists and engineers to address Air Force needs. International interactions facilitate future interoperability of coalition systems and foster relationships with future coalition partners. This Project also seeks to enhance educational interactions with historically black colleges and universities, Hispanic serving institutions, and other minority institutions.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Foster international science and technology cooperation by supporting the Air Force's international strategy mission. Identify and leverage unique foreign research capabilities.

**FY 2011 Accomplishments:**

Leveraged international expertise and supported international technology liaison missions in identifying and maintaining awareness of foreign science and technology developments. Capitalized on foreign investments by influencing and acquiring world-class scientific research. Found and maintained access to technical briefs and publications on unique foreign research capabilities. Supported international visits of high-level Department of Defense (DoD) delegations. Provided primary interface to coordinate international participation among DoD organizations.

**FY 2012 Plans:**

N/A

**FY 2013 Base Plans:**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	5.141	-	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 614113: <i>External Research Programs Interface</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2 <b>Description:</b> Strengthen science, mathematics, and engineering research as well as educational infrastructure in the U.S., thereby strengthening Air Force technical capabilities. <b>FY 2011 Accomplishments:</b> Increased awareness of Air Force research needs throughout civilian scientific community. Identified and recruited the best scientific talent to participate in critical Air Force research. Supported science, mathematics, and engineering research, and educational outreach programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions. <b>FY 2012 Plans:</b> N/A <b>FY 2013 Base Plans:</b> N/A <b>FY 2013 OCO Plans:</b> N/A	4.136	-	-	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	9.277	-	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 614113: <i>External Research Programs Interface</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>							
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>				PE 0601103F: <i>University Research Initiatives</i>							
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	127.656	152.273	141.153	-	141.153	138.747	143.700	145.131	145.204	Continuing	Continuing
615094: <i>University Research Initiatives</i>	127.656	152.273	141.153	-	141.153	138.747	143.700	145.131	145.204	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program supports defense-related basic research in a wide range of scientific and engineering disciplines relevant to maintaining U.S. military technology superiority. Research topics include, but are not limited to, transformational and high priority technologies such as nanotechnology, sensor networks, intelligence information fusion, smart materials and structures, efficient energy and power conversion, and high-energy materials for propulsion and control. The program also enhances and promotes the education of U.S. scientists and engineers in disciplines critical to maintaining, advancing, and enabling future U.S. defense technologies. For example, the National Defense Science and Engineering Graduate (NDSEG) program awards fellowships to train U.S citizens in science and engineering disciplines of military importance under a joint tri-Service and Office of the Assistant Secretary of Defense for Research and Engineering competition. Finally, this program assists universities in establishing superior instrumentation capabilities needed to improve the quality of defense-related research and education. A fundamental component of this program is the recognition that future technologies and technology exploitations require highly coordinated and concerted multi- and inter-disciplinary efforts. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 1, Basic Research, because it funds basic scientific study and experimentation.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	136.297	140.273	145.093	-	145.093
Current President's Budget	127.656	152.273	141.153	-	141.153
Total Adjustments	-8.641	12.000	-3.940	-	-3.940
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	12.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-4.000	-			
• SBIR/STTR Transfer	-3.945	-			
• Other Adjustments	-0.696	-	-3.940	-	-3.940

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 615094: *University Research Initiatives*  
Congressional Add: *Cyber Security Research*

FY 2011	FY 2012
-	12.000

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research Initiatives</i>
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<b>Congressional Add Details (\$ in Millions, and Includes General Reductions)</b>	<b>FY 2011</b>	<b>FY 2012</b>
Congressional Add Subtotals for Project: 615094	-	12.000
Congressional Add Totals for all Projects	-	12.000

**Change Summary Explanation**

FY11: Other Adjustments include: -0.696 General Congressional Reductions

FY12: Congress added \$12 million for Cyber Security Research.

Decrease in FY 2013 due to higher Department of Defense priorities.

**C. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Promote fundamental, multi- and interdisciplinary science and engineering research projects.</p> <p><b>FY 2011 Accomplishments:</b>                      Funded competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Supported and recognized superior academic researchers in the early stages of their career through the Presidential Early Career Award for Scientists and Engineers (PECASE) program. Continued funding of multi-disciplinary programs initially awarded in prior years.</p> <p><b>FY 2012 Plans:</b>                      Continue funding competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Support and recognize superior academic researchers in the early stages of their career through the PECASE program. Continue funding of multi-disciplinary programs initially awarded in prior years.</p> <p><b>FY 2013 Base Plans:</b>                      Continue funding competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Support and recognize superior academic researchers in the early stages of their career through the PECASE program. Continue funding of multi-disciplinary programs initially awarded in prior years.</p> <p><b>FY 2013 OCO Plans:</b></p>	72.765	77.852	78.341	-	78.341



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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research Initiatives</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Support post-graduate, graduate, and undergraduate education in science and engineering disciplines at U.S. universities.</p> <p><b>FY 2011 Accomplishments:</b>                      Awarded approximately 200 fellowships within the highly competitive NDSEG fellowships. Funded competitive awards for graduate and undergraduate research experiences, including those established under the Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE) program designed to increase the number of high-quality undergraduate science and engineering majors. Continued funding for awards initiated under prior year Department of Defense programs.</p> <p><b>FY 2012 Plans:</b>                      Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences, including those established under the ASSURE program. Continue funding for awards initiated under prior year Department of Defense programs.</p> <p><b>FY 2013 Base Plans:</b>                      Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences, including those established under the ASSURE program. Continue funding for awards initiated under prior year Department of Defense programs.</p> <p><b>FY 2013 OCO Plans:</b>                      N/A</p>	42.370	46.571	46.863	-	46.863
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Enhance the scientific and engineering research through advanced education infrastructure and instrumentation at U.S. universities.</p> <p><b>FY 2011 Accomplishments:</b>                      Awarded highly-competitive grants under the Defense University Research Instrumentation Program (DURIP) to U.S. universities. DURIP is designed to improve the capabilities of U.S. universities by providing grants for state-of-the-art, high technology instrumentation and infrastructure.</p> <p><b>FY 2012 Plans:</b></p>	12.521	15.850	15.949	-	15.949

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research Initiatives</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continue to award grants on a competitive basis under the DURIP to U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities. <b>FY 2013 Base Plans:</b> Continue to award grants on a competitive basis under the DURIP to U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities. <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	127.656	140.273	141.153	-	141.153

	FY 2011	FY 2012
<b>Congressional Add:</b> Cyber Security Research <b>FY 2012 Plans:</b> Conduct Congressionally-directed effort on cyber security.	-	12.000
<b>Congressional Adds Subtotals</b>	-	12.000

<b>D. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**E. Acquisition Strategy**  
N/A

**F. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>			<b>R-1 ITEM NOMENCLATURE</b>								
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>			PE 0601108F: <i>High Energy Laser Research Initiatives</i>								
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	12.748	14.258	13.094	-	13.094	13.326	13.554	13.816	14.068	Continuing	Continuing
615097: <i>High Energy Laser Research Initiatives</i>	12.748	14.258	13.094	-	13.094	13.326	13.554	13.816	14.068	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program funds basic research aimed at developing fundamental scientific knowledge to support future Department of Defense (DoD) high energy laser (HEL) systems. The HEL Joint Technology Office (JTO) sends these funds to multi-disciplinary research institutes for projects on laser and beam control technologies. In addition, funding supports educational grants to stimulate interest in HELs. These educational grants are used for educational tools, scholarships, and summer intern employees in military laboratories. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	13.198	14.258	14.094	-	14.094
Current President's Budget	12.748	14.258	13.094	-	13.094
Total Adjustments	-0.450	-	-1.000	-	-1.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.382	-			
• Other Adjustments	-0.068	-	-1.000	-	-1.000

**Change Summary Explanation**

FY11: Other Adjustments include -0.068 General Congressional Reductions.

Decrease in FY 2013 is due to higher Department of Defense priorities.

**C. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1.	8.537	9.349	8.494	-	8.494

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser Research Initiatives</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
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**Description:** Improve the fundamental understanding of HEL sources, to include solid state, free electron, and gas laser technologies.

**FY 2011 Accomplishments:**  
Completed research efforts on awarded topics in diode-pumped alkali, free electron, fiber, and bulk solid state laser technologies. Continued overseas efforts to leverage international technology advancements.

**FY 2012 Plans:**  
Initiate a new call for and continue research efforts on innovative laser technologies in diode-pumped alkali, free electron, fiber, and bulk solid state technologies. Continue overseas efforts to leverage international technology advancements.

**FY 2013 Base Plans:**  
Continue research on innovative laser technologies in diode-pumped alkali, free electron, fiber, and bulk solid state laser technologies. Continue overseas efforts to leverage international technology advancements.

**FY 2013 OCO Plans:**  
N/A

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Improve the fundamental understanding of beam control technologies, as they relate to HEL applications. Conduct research in atmospheric characterization, metrology, control systems, algorithms, and beam control component technology.</p> <p><b>FY 2011 Accomplishments:</b> Completed airborne measurements for mitigation of aero-optics effects. Completed studies to optimize HEL architectures, and optimized size, weight, and complexity of the beam control systems. Continued overseas efforts to leverage international technology advancements.</p> <p><b>FY 2012 Plans:</b> Initiate a new call for and continue research efforts in innovative beam control architectures. Continue overseas efforts to leverage international technology advancements.</p> <p><b>FY 2013 Base Plans:</b></p>	3.487	4.159	3.850	-	3.850

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser Research Initiatives</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continue research on innovative beam control architectures. Continue overseas efforts to leverage international technology advancements.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.  <b>Description:</b> Fund educational grants intended to stimulate interest in HELs among students.  <b>FY 2011 Accomplishments:</b> Provided scholarships and internships to support college students studying HEL degrees. Provided grants to Service Academies to stimulate HEL studies among military cadets. Funded publication of journals and continuing education for professionals in the HEL field.  <b>FY 2012 Plans:</b> Provide scholarships and internships to support college students studying HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Fund publication of journals and continuing education for professionals in the HEL field.  <b>FY 2013 Base Plans:</b> Provide scholarships and internships to support college students studying HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Fund publication of journals and continuing education for professionals in the HEL field.  <b>FY 2013 OCO Plans:</b> N/A	0.724	0.750	0.750	-	0.750
<b>Accomplishments/Planned Programs Subtotals</b>	12.748	14.258	13.094	-	13.094

<b>D. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**E. Acquisition Strategy**  
N/A

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 1: <i>Basic Research</i>	PE 0601108F: <i>High Energy Laser Research Initiatives</i>

**F. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	136.846	144.219	114.166	-	114.166	121.176	120.257	119.996	119.047	Continuing	Continuing
624347: <i>Materials for Structures, Propulsion, and Subsystems</i>	85.962	89.908	58.464	-	58.464	63.328	55.443	55.326	55.289	Continuing	Continuing
624348: <i>Materials for Electronics, Optics, and Survivability</i>	30.985	30.419	28.805	-	28.805	31.562	31.774	31.156	31.187	Continuing	Continuing
624349: <i>Materials Technology for Sustainment</i>	16.170	20.050	26.897	-	26.897	26.286	33.040	33.514	32.571	Continuing	Continuing
624915: <i>Deployed Air Base Technology</i>	3.729	3.842	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, sustainability, availability, affordability, supportability, reliability, and survivability of current and future Air Force systems and operations. The program has five projects that develop: (1) the materials and processing technology base for spacecraft and launch systems; (2) structural, propulsion, and sub-systems materials and processes technologies; (3) electronic, optical, and survivability materials and processes technologies; (4) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (5) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Efforts in the program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary materials technologies.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	137.273	136.230	136.277	-	136.277
Current President's Budget	136.846	144.219	114.166	-	114.166
Total Adjustments	-0.427	7.989	-22.111	-	-22.111
• Congressional General Reductions	-	-0.011			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	8.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.738	-			
• SBIR/STTR Transfer	-0.822	-			
• Other Adjustments	1.133	-	-22.111	-	-22.111

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>
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**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 624347: *Materials for Structures, Propulsion, and Subsystems*

Congressional Add: *Nanotechnology Research*

Congressional Add Subtotals for Project: 624347

Congressional Add Totals for all Projects

	FY 2011	FY 2012
	-	8.000
	-	8.000
	-	8.000

**Change Summary Explanation**

FY11: Other Adjustments include 2.400 Congressional Add and -1.267 Congressional General Reductions

FY12: Congressional Add for Nanotechnology research

Decrease in FY13 is due to higher Department of Defense priorities.



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>				<b>PROJECT</b> 624347: <i>Materials for Structures, Propulsion, and Subsystems</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
624347: <i>Materials for Structures, Propulsion, and Subsystems</i>	85.962	89.908	58.464	-	58.464	63.328	55.443	55.326	55.289	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops the materials and processing technology base for aircraft, spacecraft, launch systems, and missiles to improve affordability, maintainability, and performance of current and future Air Force systems. A family of affordable lightweight materials is being developed, including metals, polymers, ceramics, metallic and nonmetallic composites, and hybrid materials to provide upgraded capabilities for existing aircraft, missile, and propulsion systems to meet the future system requirements. Develops high-temperature turbine engine materials that will enable engine designs to double the turbine engine thrust-to-weight ratio. Advanced high temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet aerospace and missile requirements. Alternative or replacement materials are being developed to maintain the performance of aging operational systems. Materials for thermal management including coolants, adaptive thermally conductive materials, coatings, friction and wear-resistant materials, and other pervasive nonstructural materials technologies are being developed for directed energy, propulsion, and subsystems on aircraft, spacecraft, and missiles. Develops nanostructured and biological materials for aircraft structures, munitions, air vehicle subsystems, and personnel. Develops novel materials for electromagnetic interactions with matter for electromagnetic pulse (EMP), high power microwave, and lightning strike protection. Concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop ceramic, ceramic matrix composite, and hybrid materials technologies for performance and supportability improvement in propulsion systems and high temperature aerospace structures.</p> <p><b>FY 2011 Accomplishments:</b> Initiated development of new advanced processing methods, environmental coatings, and life prediction for higher temperature capable ceramic matrix composites. Continued validation of the life prediction model to address time dependent degradation associated with environmental exposure. Continued validation of the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing. Initiated development of new ceramic matrix composite systems with higher temperature capability. Completed assessment of thermal protection system materials for hypersonic applications. Continued development of suitable materials and materials process technologies for application in combined optical and radio frequency (RF) communication system apertures.</p> <p><b>FY 2012 Plans:</b></p>	13.242	12.630	17.628	-	17.628

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624347: <i>Materials for Structures, Propulsion, and Subsystems</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Advance development of new processing methods, environmental coatings, and life prediction for higher temperature capable ceramic matrix composites. Continue validation of the life prediction model to address time dependent degradation associated with environmental exposure. Continue validation of the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing. Continue development of new ceramic matrix composites systems with higher temperature capability. Continue validation of suitable materials and materials process technologies for applications in combined optical and RF communication system apertures. Initiate development of new hybrid materials and materials process technologies for applications in combined optical and RF communication system apertures.</p> <p><b>FY 2013 Base Plans:</b> Continue development of new advanced processing methods, coating technologies, and behavioral life prediction for higher temperature capable ceramic matrix composites. Transition life prediction model to address time dependent degradation associated with environmental exposure. Demonstrate severe environment durability of advanced ceramic composite systems via mechanical testing. Advance development of new ceramic matrix composites systems with higher temperature capability. Demonstrate materials and processes for applications in combined optical and RF communication system apertures. Continue development of new hybrid materials and processes for applications in combined optical and RF communication system apertures. Use computational analysis to enhance understanding of environment for structural characterization. Increase in FY13 due to higher Air Force priority on hypersonic research.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop nanostructured materials and nanoscale architectures to address electromagnetic applications. Develop metamaterials for sensors, antennas, electronics, and optical elements.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of material concepts for adaptive and multifunctional aircraft structures. Validated and demonstrated materials and process low-cost processing methodologies for photovoltaics for remotely piloted aircraft applications. Investigated new materials systems and nano geometries to improve electrochemical energy storage including development of long-life electrodes. Advanced concepts for RF passive metamaterials-based components. Explored RF/Infrared (IR) photonics for compact air vehicle applications. Developed</p>	22.395	21.455	6.669	-	6.669

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
fabrication and characterization for Electro-optic (EO)/IR metamaterials. Developed fabrication and characterization for emerging metamaterial applications.					
<b>FY 2012 Plans:</b> Continue to investigate new materials systems and nano geometries to improve electrochemical energy storage including development of long-life electrodes. Accelerate applications development for optical metamaterials. Continue to investigate concepts for RF passive metamaterials-based components. Continue to develop RF/IR photonics for compact air vehicle applications. Continue to develop fabrication and characterization for EO/IR metamaterials. Develop fabrication and characterization for emerging metamaterial applications.					
<b>FY 2013 Base Plans:</b> Demonstrate concepts for RF Passive metamaterials-based components. Demonstrate use of RF/IR photonics for compact air vehicle applications. Decrease in FY13 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 3					
<b>Description:</b> Develop lightweight metallic/inter-metallic high temperature materials, life prediction, and metals processing technologies for sustainment issues such as lower costs, increased durability, and improved reliability.					
<b>FY 2011 Accomplishments:</b> Continued development of an advanced disk system concept for insertion into advanced propulsion concepts for air platforms. Continued development of advanced computation methods to support modeling of materials for advanced propulsion systems. Continued development and demonstration of lightweight metallic thermal protection systems. Optimized fabrication methods for hybrid composite material systems. Continued development and validation of quantitative, predictive models for performance of metallic-based thermal management systems.					
<b>FY 2012 Plans:</b> Continue development of advanced blade and disk system concept for insertion into advanced propulsion concepts for air platforms. Continue development of advanced computation methods to support material development and characterization modeling for advanced aerospace systems. Continue development and validation of quantitative, predictive models for performance of metallic-based thermal management systems.					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	14.082	13.442	20.566	-	20.566

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Determine relationships between microstructure, processing, and the functional properties and performance of metallic, hybrid, nano, and composite materials.  <b>FY 2013 Base Plans:</b> Transition advanced blade and disk system into advanced turbine engine systems. Demonstrate advanced computation methods to support material development and characterization modeling. Demonstrate quantitative, predictive models for performance of metallic based thermal management systems. Analyze relationships between microstructure, processing, functional properties, and performance of metallic, hybrid, nanoscale, and composite materials. Increase in FY13 due to higher Air Force priority in turbine engines.  <b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 4  <b>Description:</b> Explore new material systems for expendable supersonic/hypersonic weapon system applications. Develop and evaluate lightweight, active, adaptive, multifunctional, high temperature, and durable composite and hybrid materials for extreme environments. Develop composite and hybrid life prediction tools for engine and airframe applications. Develop computational materials science techniques and models to characterize high performance materials for expendable space and hypersonic/hypersonic applications.  <b>FY 2011 Accomplishments:</b> Continued to demonstrate new materials for space and high-speed vehicle applications. Continued to explore composite/hybrid life prediction tools and advanced composite/hybrid materials for engine and airframe applications. Continued to explore novel high-performance coolants, thermoelectric materials, and multi-scale predictive tools for thermal management. Continued to integrate ceramic and metallic Thermal Protection System subcomponents and evaluated in a relevant space environment.  <b>FY 2012 Plans:</b> Continue to demonstrate improved performance of new material systems for space and supersonic/hypersonic vehicle applications. Continue to develop lightweight, active, adaptive, multifunctional, high temperature, and durable composite and hybrid materials for extreme environments including hypersonic applications. Evaluate advanced carbon fibers modified by carbon nanotubes. Develop tailorable/adaptive high performance thermal interfaces, coolants, thermoelectric, and energy storage materials and models for air, space, propulsion, and directed energy applications. Initiate development of novel materials and processes for improved thermal transport, storage, and thermal management for Air Force applications. Continue to transition high-performance	16.111	15.309	6.821	-	6.821

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
material systems for space and high-speed vehicle applications. Develop composite and hybrid life prediction tools for engine and airframe applications.					
<b>FY 2013 Base Plans:</b> Further demonstrate and transition improved material systems for space and supersonic/hypersonic vehicle applications. Continue to develop lightweight, active, adaptive, multifunctional, high temperature, and durable composite and hybrid materials for extreme environments including hypersonic applications. Evaluate advanced carbon fibers modified by carbon nanotubes. Develop tailorable/adaptive high performance thermal interfaces, coolants, thermoelectric, and energy storage materials and models for air, space, propulsion, and directed energy applications. Initiate development of novel materials and processes for improved thermal transport, storage, and thermal management for Air Force applications. Continue to transition high-performance material systems for space and high-speed vehicle applications. Develop composite and hybrid life prediction tools for engine and airframe applications. Decrease in FY13 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 5					
<b>Description:</b> Develop materials for power, fluids, lubricants, aircraft topcoat, and corrosion resistant coatings using alternative energy and bio-inspired concepts.					
<b>FY 2011 Accomplishments:</b> Continued to develop combined thermal/friction coating materials for extreme environments. Analyzed integration and continue development of alternative/renewable material and technologies for agile and adaptive deployed applications.					
<b>FY 2012 Plans:</b> Continue development of alternative/renewable energy materials and technologies for deployed applications, including biomass and other alternative energy solutions. Continue to develop combined thermal/friction coating materials for extreme environments.					
<b>FY 2013 Base Plans:</b> Decrease in FY13 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	2.988	2.688	-	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A.					
<b>Title:</b> Major Thrust 6					
<b>Description:</b> Develop the basic nanomaterial building blocks for munitions and propulsion energetic systems. Develop fundamental Science and Technology for pervasive device processing mechanisms via bio-inspired concepts and nanoscale technologies.					
<b>FY 2011 Accomplishments:</b> Demonstrated nanomaterials that provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions, high efficiency air-breathing propulsion, and access to space. Developed understanding of rapid propulsion methods for nano bio-material devices for aircraft and space structures, actuators, sensors, and electronics. Demonstrated the transport and compartmentalization of nanoparticles being investigated as nanoenergetics to evaluate potential environmental impact. Validated microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems.					
<b>FY 2012 Plans:</b> Demonstrate and validate nanomaterials for structural nano-energetic (SNE) munitions, high efficiency air-breathing propulsion, and access to space. Develop biological engineering methods to facilitate the generation of sensors, materials, and electro-optic devices for production of complex hybrid materials. Investigate the confluence on nano-materials and bio-materials focusing on transitioning mechanical optical or electronic devices based upon nano-materials and bio-materials.					
<b>FY 2013 Base Plans:</b> Develop and analyze nano-biomaterials for human performance sensing. Develop computation materials science techniques and models to characterize nanomaterials. Decrease in FY13 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 7					
<b>Description:</b> Develop high temperature materials, structures, and thermal management concepts to enable future defense capabilities for prompt global strike concepts.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	14.383	13.732	6.780	-	6.780
	2.761	2.652	-	-	-

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continued to investigate advanced ceramics, ceramic matrix composites, hybrids, and metallic concepts for hot structure and thermal protection systems. <b>FY 2012 Plans:</b> Develop advanced ceramics, ceramic matrix composites, hybrids, and metallic concepts for reuseable hot structure and thermal protection systems. <b>FY 2013 Base Plans:</b> Decrease in FY13 due to higher Department of Defense priorities. <b>FY 2013 OCO Plans:</b> N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	85.962	81.908	58.464	-	58.464

	FY 2011	FY 2012
<b>Congressional Add:</b> Nanotechnology Research <b>FY 2011 Accomplishments:</b> N/A. <b>FY 2012 Plans:</b> Conducted Congressionally-directed effort.	-	8.000
<b>Congressional Adds Subtotals</b>	-	8.000

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A.: N/A.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624348: <i>Materials for Electronics, Optics, and Survivability</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624348: <i>Materials for Electronics, Optics, and Survivability</i>	30.985	30.419	28.805	-	28.805	31.562	31.774	31.156	31.187	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops materials technologies for surveillance and situational awareness systems and subsystems for aircraft and missile applications, including sensor, microwave, and infrared detection and countermeasures devices used for targeting, electronic warfare, and active aircraft protection. Materials for protection of aircrews, sensors, and aircraft from laser and high-power microwave directed energy threats are also developed. Electronic and optical materials are being developed to enable surveillance and situational awareness with faster operating speeds, greater tunability, higher power output, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. New materials are being developed to counter the most prominent laser threats and to respond to emerging and agile threat wavelengths without impairing mission effectiveness.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop IR detector and hybrid materials, Materials and Processes (M&amp;P) technologies for performance, affordability, and operational capability of surveillance, tracking, targeting, and situational awareness systems.</p> <p><b>FY 2011 Accomplishments:</b> Optimized 2000 pixel by 2000 pixel (2k x 2k) detector and readout integrated circuit design, processing, and packaging for enhanced focal plane array yields. Furthered IR materials development for long wavelength. Advanced mid wavelength materials development for high temperature, low-noise operation for use on low-power systems. Modeled and evaluated optical behavior of materials for Low Observable (LO), Intelligence, Surveillance, Reconnaissance (ISR), and other applications. Explored enhancing detection capability of three-dimensional detection. Investigated next generation alternative three-dimension schemes. Scaled up growth technology for nano-scale IR. Advanced novel nano-scale materials options. Continued to model and evaluate materials optical/IR behavior for LO, ISR, and other applications.</p> <p><b>FY 2012 Plans:</b> Demonstrate reproducibility of optimized 2k x 2k detector and readout integrated circuit design, processing, and packaging for enhanced focal plane array yields. Develop a superlattice based material system for use in the detector elements of very long wavelength IR detector focal plane arrays. Continue to advance mid wavelength materials development for high temperature, low-noise operation for use on low-power systems. Validate</p>	8.473	8.295	9.362	-	9.362



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>models of materials optical/IR behavior for LO, ISR, and other applications. Initiate development of materials for nano-scale detection.</p> <p><b>FY 2013 Base Plans:</b> Transition optimized design of 2k x 2k IR detectors with integrated circuits, processing, and packaging for enhanced focal plane array yields. Continue to develop a super-lattice based material system for use in the detector elements of very-long wavelength IR detector focal plane arrays. Operate a mid-wavelength IR focal plane array at temperatures above 200 Kelvin to demonstrate overcoming the challenge of cryogenic cooling requirements. Transition mid-wavelength materials for high temperature, low-noise sensing for use on low power systems. Demonstrate models of materials optical/infrared behavior for LO, ISR, and other applications. Continue to develop nano-scale materials for use in producing detectors. Utilize computational materials science to improve performance prediction models.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop and demonstrate technologies to enhance the safety, survivability, and mission effectiveness of aircrews, sensors, viewing systems, and related assets.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated optimized nonlinear optical limiter materials for damage protection. Demonstrated enhanced photorefractive hybrid materials concepts for Air Force passive protection applications. Matured improved liquid crystal materials for photo-tunable devices for sensor system protection concepts. Demonstrated thin film growth capabilities for enhanced fixed filter performance. Demonstrated semiconductor optical limiter materials performance for damage protection in the short wave infrared.</p> <p><b>FY 2012 Plans:</b> Continue demonstration of optimized nonlinear optical limiter materials for damage protection. Continue to develop new optical limiter materials and material technologies for robust in-band protection. Continue demonstration of enhanced photorefractive hybrid materials concepts for Air Force passive protection applications. Develop tunable/switchable materials and concepts to provide jamming protection to a variety of</p>	8.913	8.728	11.818	-	11.818

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
systems. Develop and demonstrate passive optical coating technology for advanced applications in airborne, space, and personnel systems. <b>FY 2013 Base Plans:</b> Continue development and demonstration of materials and technologies to protect against directed energy threats. Projects include optimized nonlinear optical limiter materials for damage protection, robust in-band optical limiter materials, enhanced photorefractive hybrid materials concepts, tunable/switchable materials and concepts, and passive optical coating technology for advanced applications in airborne, space, and personnel systems. Develop materials for high energy laser interactions. Utilize computational materials science to enhance multi-scale modeling. <b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 3 <b>Description:</b> Develop M&P technologies for power generation and control, and microwave components for surveillance, tracking, targeting, situational awareness, and lethal and non-lethal systems. <b>FY 2011 Accomplishments:</b> Developed materials growth adjustment/mitigation methodologies for improved reliability. Improved materials and materials applications for increased reliability and power for high power microwave directed energy applications. <b>FY 2012 Plans:</b> Develop and validate characterization and modeling tools to analyze material changes that occur at the nanoscale within an operating device. Develop and demonstrate reliable materials and processes to optimize components for compact, lightweight, high power microwave directed energy applications. Continue to develop nanostructured materials using multiple approaches for high energy density capacitors for pulsed power applications. <b>FY 2013 Base Plans:</b> Continue to develop modeling tools to analyze material changes that occur at the nanoscale within an operating device. Continue to develop and demonstrate reliable materials and processes to optimize components for compact, lightweight, high power microwave directed energy applications. <b>FY 2013 OCO Plans:</b>	5.701	5.610	3.701	-	3.701

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A.					
<b>Title:</b> Major Thrust 4					
<b>Description:</b> Develop enabling and foundational biotechnologies for guidance and control, rapid tagging, tracking, and identification of targets, and bio-integrated electronics and sensing.					
<b>FY 2011 Accomplishments:</b> Developed new bio-materials and nano-materials that enable broad spectrum mitigation of environmental threats. Integrated delivery methods and bio-materials and nano-materials appropriate for specific Air Force requirements. Demonstrated materials with specific performance characteristic.					
<b>FY 2012 Plans:</b> Develop bio-materials and nano-based and functionalized materials for tagging, tracking, and locating applications. Develop biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Develop bio-materials and nano-materials that enable broad spectrum mitigation of environmental threats.					
<b>FY 2013 Base Plans:</b> Continue to develop biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Use pervasive computational materials science to model guided experiments and to enable rapid in-situ experimental data acquisition.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 5					
<b>Description:</b> Develop materials enabling higher performance lasing media, new laser architectures, optical isolators, beam steering, and other high energy laser components for directed energy.					
<b>FY 2011 Accomplishments:</b> Pursued materials for enabling improved laser source components operating in the mid-infrared range. Improved very high-speed beam steering materials and pursued most promising beam steering configurations. Improved materials to increase high energy laser efficiency and gain.					
<b>FY 2012 Plans:</b>					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	4.860	4.730	1.177	-	1.177
	3.038	3.056	2.747	-	2.747

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Develop materials for enabling improved laser source components operating in the mid-infrared range. Continue to develop materials processes for fabricating new laser beam scanning architectures that utilize the latest generation of EO polymers to enable the high-speed beam steering. Develop and demonstrate materials that increase high energy laser efficiency and gain.					
<b><i>FY 2013 Base Plans:</i></b> Demonstrate materials for improved laser source components operating in the mid-infrared range. Develop materials with tailorable properties for beam steering in the newly accessible W band. Demonstrate materials processes for fabricating new laser beam scanning devices that utilize electro-optic polymers to enable high-speed beam steering. Develop and demonstrate materials that increase high energy laser efficiency and output. Utilize computational materials science to improve performance predictions and shorten design cycle time.					
<b><i>FY 2013 OCO Plans:</i></b> N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	30.985	30.419	28.805	-	28.805

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A.: N/A.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624349: <i>Materials Technology for Sustainment</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624349: <i>Materials Technology for Sustainment</i>	16.170	20.050	26.897	-	26.897	26.286	33.040	33.514	32.571	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops materials and materials processing technologies to support operational Air Force mission areas by providing the ability to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing a capability to detect and characterize performance threatening defects, characterizing materials processes and properties necessary for materials transition, and providing quick reaction support and failure analysis to the operational commands and repair centers. Repair techniques and nondestructive inspection/evaluation (NDI/E) methods are developed that are needed for metallic and non-metallic structures, coatings, corrosion control processes, and to support integration of composite structures for aerospace systems. Various NDI/E methods are essential to ensure optimum quality in the design and production of aircraft, propulsion, and missile systems. These NDI/E methods are also essential to monitor and detect the onset of any service-initiated damage and/or deterioration due to aging of operational systems.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop sensing and life prediction technologies to identify damage and characterize the health of aging structures, propulsion systems, and low-observable (LO) materials and structures.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated advanced novel sensing techniques to detect and track corrosion and other damage to materials in aerospace systems. Demonstrated augmented multi-layer sensing capabilities to demonstrate applications and damage models for a wide variety of aerospace structures. Demonstrated sensing technologies that detect changes in material properties from corrosion and in-field use, damage evolution, and other factors that detrimentally affect aerospace systems. Developed and validated affordable prognosis approaches for life cycle sustainment and management and for life extension capability. Demonstrated novel LO point inspection probes to enable rapid assessment of LO material performance. Investigated next generation LO point inspection needs.</p> <p><b>FY 2012 Plans:</b> Advance novel sensing modeling, methods, and techniques to detect and track damage to other materials and components for aerospace systems. Investigate enhanced sensing through multiple layers of skin and structures to improve the probabilities of finding deeply imbedded or hidden damage in aerospace systems. Advance sensing technologies that detect changes in material properties, damage evolution, and other factors</p>	4.862	7.153	12.487	-	12.487

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
that detrimentally affect aerospace systems. Develop and improve affordable prognosis approaches for life cycle management and life extension capability for aerospace structure and turbine engines. Investigate and augment innovative LO point inspection probes to enable rapid assessment of LO material performance.  <b>FY 2013 Base Plans:</b> Continue to advance novel sensing modeling, methods, and techniques to detect, characterize, and track materials state awareness in aerospace system components. Continue to investigate enhanced sensing through multiple layers of materials and structures to improve the probabilities of finding deeply imbedded or hidden damage in aerospace systems. Advance sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Demonstrate design assessment of reliability of affordable prognosis approaches to life cycle management and life extension for aerospace structures and turbine engines. Continue to develop innovative LO point inspection probes to enable rapid assessment of LO material performance. Increase in FY13 due to correction in applying overhead costs of laboratory space to Major Thrust.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 2  <b>Description:</b> Develop support capabilities, information, and processes to resolve problems with materials in the production and repair of systems components and structures.  <b>FY 2011 Accomplishments:</b> Evaluated advanced materials and processes technology to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Developed and demonstrated test methods and techniques to understand the effects of in-service environments and materials processes, such as the application of residual stress on the surface of steel and other structural metals, to support studies and point design solutions that will extend the life of specific structural components on Air Force systems. Demonstrated and transitioned technologies for improved maintainability and life cycle cost of advanced materials and designs, such as conductive outer-mold-line, films, coatings, access panel treatments and multifunctional systems. Developed and demonstrated laboratory test methods to evaluate and characterize candidate space materials for properties and material behavior suitable for use in space applications.  <b>FY 2012 Plans:</b>	4.919	6.053	4.370	-	4.370

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>Evaluate advanced materials and processes technology to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Develop and demonstrate test methods and techniques to understand the effects of in-service environments, residual stress and materials processes on structural materials, and to support studies and point design solutions that will extend the life of specific structural components on Air Force systems. Demonstrate and transition technologies for improved maintainability and life cycle cost of advanced materials and designs, such as conductive outer-mold-line, aircraft films, coatings, access panel treatments, and multifunctional systems. Develop and demonstrate laboratory test methods to evaluate and characterize candidate space materials for properties and material behavior suitable for use in space applications.</p> <p><b>FY 2013 Base Plans:</b> Continue to evaluate advanced materials and processes technology to repair Air Force legacy systems. Investigate failure limits for emerging Air Force systems. Validate and demonstrate test methods and techniques to understand effects of service environments, residual stresses, and material processes on structural materials. Conduct studies and support designs that will extend the life of specific structural components on Air Force systems. Transition advanced materials technologies and designs for improved maintainability and life cycle cost of conductive outer-moldline films, coatings, access panel treatments, and multifunctional systems. Continue to develop and demonstrate laboratory test methods to evaluate and characterize materials for properties and behaviors suitable for space applications. Use computational materials science to perform 3D analysis to predict and analyze material boundary conditions.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>					
<p><b>Title:</b> Major Thrust 3</p> <p><b>Description:</b> Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components.</p> <p><b>FY 2011 Accomplishments:</b> Performed quick response failure analysis and materials investigations for fielded system, acquisition organization, depot system materials failures, and provided advanced materials solutions to ensure system availability and safety of flight. Developed advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrated advanced test methodologies for analyzing</p>	6.389	6.844	10.040	-	10.040

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
structural failures of emerging materials for Air Force systems. Developed advanced wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapon systems.  <b>FY 2012 Plans:</b> Perform quick response failure analysis and materials investigations. Provide advanced materials solutions to ensure system availability and safety of flight. Initiate development of Microelectromechanical System (MEMS) failure analysis capabilities. Develop advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrate advanced test methodologies for analyzing electrical and structural failures of emerging materials. Develop and demonstrate advanced wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapon systems.  <b>FY 2013 Base Plans:</b> Continue to perform quick response failure analyses and materials investigations. Continue to provide advanced materials solutions to ensure critical warfighter system availability and safety of flight. Continue development of Microelectromechanical System (MEMS) failure analysis capabilities. Validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Transition advanced test methods for analyzing electrical and structural failures of emerging materials. Validate and demonstrate advanced wiring materials technologies to replace aging wiring systems. Validate and demonstrate new wiring technologies for emerging weapon systems. Increase in FY13 due to correction in applying overhead costs of laboratory space to Major Thrust.  <b>FY 2013 OCO Plans:</b> N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	16.170	20.050	26.897	-	26.897

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A.: N/A.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624349: <i>Materials Technology for Sustainment</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624915: <i>Deployed Air Base Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624915: <i>Deployed Air Base Technology</i>	3.729	3.842	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs, and to improve protection and survivability of deployed Air Expeditionary Force (AEF) warfighters. Affordable, efficient technologies are developed for base infrastructure, fire fighting, and force protection to improve Expeditionary Combat Support operations.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop deployable infrastructure airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations.</p> <p><b>FY 2011 Accomplishments:</b> Developed and demonstrated deployable applications of higher efficiency collection and conversion of solar power for deployed applications. Developed and optimized performance of candidate high temperature operating surface materials. Developed and improved remote and autonomous non-destructive inspection of airfield surface evaluation technologies.</p> <p><b>FY 2012 Plans:</b> Investigate and develop innovative airbase alternative energy generation capability, power grid conditioning, and distribution methods. Explore and continue development of high operating temperature materials and technologies for aircraft operating surfaces.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY13 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>	1.862	1.974	-	-	-
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop affordable technologies to provide force protection and survivability to AEF deployed warfighters and infrastructure.</p>	1.867	1.868	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624915: <i>Deployed Air Base Technology</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b><i>FY 2011 Accomplishments:</i></b> Developed and optimized fire suppression agents using methodologies supporting deployed warfighters and infrastructure. Developed novel cost-effective technologies for fire fighter effectiveness in deployed environments. Developed novel structural materials and technologies to support deployed warfighters and infrastructure using methodologies developed for protection from emerging threats. Developed and optimized techniques and materials for defeat of new and evolving improvised explosive devices and high energy threats. Analyzed functions of microbes and develop effective methodologies to capture biological processes for use in Air Force applications, such as sensing and development of solid state materials. Evaluated design and performance of microbial-based technologies.</p> <p><b><i>FY 2012 Plans:</i></b> Develop technologies for airbase structural protection against blast and fragmentation. Explore technology to enhance structural integrity. Investigate composite material combustion processes and develop modeling for aircraft fires. Develop innovative technologies for airbase fire fighting.</p> <p><b><i>FY 2013 Base Plans:</i></b> Decrease in FY13 due to higher Department of Defense priorities.</p> <p><b><i>FY 2013 OCO Plans:</i></b> N/A.</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	3.729	3.842	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A.: N/A.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing

**D. Acquisition Strategy**  
Not Applicable.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>							
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				PE 0602201F: <i>Aerospace Vehicle Technologies</i>							
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
Total Program Element	140.261	147.628	120.719	-	120.719	128.975	129.818	132.858	137.912	Continuing	Continuing
622401: <i>Structures</i>	42.918	47.116	42.021	-	42.021	44.428	43.325	44.920	47.197	Continuing	Continuing
622403: <i>Flight Controls and Pilot-Vehicle Interface</i>	38.321	39.295	36.189	-	36.189	37.661	36.280	36.860	35.352	Continuing	Continuing
622404: <i>Aeromechanics and Integration</i>	59.022	61.217	42.509	-	42.509	46.886	50.213	51.078	55.363	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program investigates, develops, and analyzes aerospace vehicle technologies in the three primary areas of structures, controls, and aeromechanics. Advanced structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Flight control technologies are developed and simulated for aerospace vehicles. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analyses. Resulting technologies improve performance of existing and future manned and remotely piloted air and space access vehicles. Improvements include, but are not limited to, reduced energy use by efficient air platform designs, use of lightweight composite structures and improved sustainment methods based on the condition of the platform and sub-systems. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

<b><u>B. Program Change Summary (\$ in Millions)</u></b>	<b><u>FY 2011</u></b>	<b><u>FY 2012</u></b>	<b><u>FY 2013 Base</u></b>	<b><u>FY 2013 OCO</u></b>	<b><u>FY 2013 Total</u></b>
Previous President's Budget	144.699	147.628	143.845	-	143.845
Current President's Budget	140.261	147.628	120.719	-	120.719
Total Adjustments	-4.438	-	-23.126	-	-23.126
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.881	-			
• SBIR/STTR Transfer	-1.381	-			
• Other Adjustments	-1.176	-	-23.126	-	-23.126

**Change Summary Explanation**

FY11: Other Adjustments include -1.176 General Congressional Reductions

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	PE 0602201F: <i>Aerospace Vehicle Technologies</i>

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622401: <i>Structures</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622401: <i>Structures</i>	42.918	47.116	42.021	-	42.021	44.428	43.325	44.920	47.197	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new concepts and design techniques. New structural concepts include incorporating subsystem hardware items and adaptive mechanisms into the aerospace structures and/or skin of the platform.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes.</p> <p><b>FY 2011 Accomplishments:</b> Continued the development of health reasoners for determination of system health. Incorporated newly developed analysis tools. Continued the development of failure criteria tools for advanced high temperature aircraft components and concepts. Continued the development of residual stress processes to enhance service life.</p> <p><b>FY 2012 Plans:</b> Continue the development of integrated sensors for determination of system health. Incorporate newly developed analysis tools. Continue the development of failure criteria tools for advanced high temperature aircraft components and concepts. Initiate efforts for condition based maintenance of structural integrity.</p> <p><b>FY 2013 Base Plans:</b> Continue development of engineered residual stress concepts, analysis, and applications. Continue the development concepts for risk informed decision making. Continue efforts for condition-based maintenance of structural integrity. Complete the development of integrated sensors for determination of system health. Continue the development of failure criteria tools for advanced aircraft components and concepts. Note: In FY 2013, efforts in this thrust are increased due to higher AF priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	17.514	19.763	24.502	-	24.502
<p><b>Title:</b> Major Thrust 2.</p>	6.432	6.897	3.075	-	3.075

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622401: <i>Structures</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
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<p><b>Description:</b> Develop methodologies to reduce the cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.</p> <p><b>FY 2011 Accomplishments:</b> Continued development of analytical certification methodologies that incorporate advanced methods. Initiated increased fidelity of analytical methodologies. Continued the development of reliability-based certification.</p> <p><b>FY 2012 Plans:</b> Continue development of methodologies that will allow for lower cost analytical certification of advanced designed structure. Initiate the development of advanced aircraft flutter analysis tools.</p> <p><b>FY 2013 Base Plans:</b> Continue development of multi-disciplinary methodologies that will allow for lower cost analytical certification of advanced designed structure. Continue experimental validation of integrated system health management technologies for aircraft subsystems. Continue the development of advanced aircraft flutter analysis tools. Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
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<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop design methods to capitalize on new materials, multi-role considerations, and integration of various subsystem hardware items and adaptive mechanisms into the actual aircraft.</p> <p><b>FY 2011 Accomplishments:</b> Continued the development of technologies to increase the survivability and performance of future systems. Developed and demonstrated system level thermal management concepts to meet the need of multi-function, multi-role, and adaptive aircraft.</p> <p><b>FY 2012 Plans:</b> Continue the development of technologies to increase the survivability and performance of future systems. Develop and demonstrate system level thermal management concepts to meet the need of multi-function, multi-role, and adaptive aircraft.</p> <p><b>FY 2013 Base Plans:</b></p>	7.923	8.562	2.366	-	2.366
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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>		<b>PROJECT</b> 622401: <i>Structures</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Continue the development of low-cost technologies to increase the survivability and performance of future systems. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Develop technologies that will permit the structural development of platforms that can operate at an extreme altitude, while at sustained speeds greater than Mach 2.					
<b>FY 2011 Accomplishments:</b> Further developed technologies for integrated air vehicle structures that can withstand extreme flight environments. Refined operationally responsive space access concepts and applied these technologies for lower cost, reduced weight expendable vehicle airframes.					
<b>FY 2012 Plans:</b> Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continue to develop structural concepts and analysis methods for design and evaluation of hot primary structure. Continue to refine operationally responsive space access concepts and apply these technologies for lower cost, reduced weight expendable vehicle airframes.					
<b>FY 2013 Base Plans:</b> Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continue to develop structural concepts and analysis methods for design and evaluation of hot primary structure. Complete the refinement of operationally responsive space access concepts and apply these technologies for lower cost, reduced weight expendable vehicle airframes.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>					
	11.049	11.894	12.078	-	12.078
	42.918	47.116	42.021	-	42.021

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622401: <i>Structures</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622403: <i>Flight Controls and Pilot-Vehicle Interface</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622403: <i>Flight Controls and Pilot-Vehicle Interface</i>	38.321	39.295	36.189	-	36.189	37.661	36.280	36.860	35.352	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops technologies that enable maximum affordable capability from manned and unmanned aerospace vehicles. Advanced flight control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous remotely piloted air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop advanced flight control systems, components, and integrated vehicle monitoring systems for both manned and remotely piloted aircraft.</p> <p><b>FY 2011 Accomplishments:</b> Furthered the development of advanced control mechanization technologies to provide highly reliable operations for aerospace systems under adverse environments. Initiated development of control architecture enhancements for complex and adaptive remotely piloted systems.</p> <p><b>FY 2012 Plans:</b> Further the assessment of advanced control technologies. Refine development of control architecture enhancements for remotely piloted systems.</p> <p><b>FY 2013 Base Plans:</b> Further the development, assessment, and certification capability of advanced flight control mechanization technologies for highly reliable operations under adverse environments. Continue development of control configurations for small unmanned air systems. Continue development of control systems hardening and health assessment technologies for enhanced survivability. Note: In FY 2013, efforts in this thrust are increased due to higher AF priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	8.916	9.642	16.304	-	16.304
<p><b>Title:</b> Major Thrust 2.</p>	13.664	13.808	12.942	-	12.942

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622403: <i>Flight Controls and Pilot-Vehicle Interface</i>			
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Description:</b> Develop flight control systems that will permit safe interoperability between manned and remotely piloted aircraft.</p> <p><b>FY 2011 Accomplishments:</b> Continued assessment of cooperative control techniques of heterogeneous systems for close-in surveillance. Continued technology development for the safe interoperability of multiple remotely piloted aircraft.</p> <p><b>FY 2012 Plans:</b> Continue performance analysis of mixed-initiative control of multi-remotely piloted aircraft packages. Refine the development and assessment of adaptive guidance and control technologies for fault/damage tolerance and rapid flight planning of aerospace vehicle operations.</p> <p><b>FY 2013 Base Plans:</b> Further the development and assessment of advanced control automation techniques and adaptive algorithms to enable the safe integration of unmanned aircraft into mission operations. Continue the development of cooperative control techniques for heterogeneous teams, as well as the integration of unmanned systems into controlled airspace and ground operations.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles.</p> <p><b>FY 2011 Accomplishments:</b> Refined assessment of advanced aerospace vehicle concepts and technologies under realistic mission conditions. Refined simulation analyses and multi-directorate technology trade studies on strike, transport, access-to-space, and reconnaissance concepts.</p> <p><b>FY 2012 Plans:</b> Continue to conduct simulation events to evaluate emerging flight control technologies and concepts. Refine technology trade studies of remotely piloted air vehicles in manned/remotely piloted airspace and airbase operations.</p> <p><b>FY 2013 Base Plans:</b></p>	15.741	15.845	6.943	-	6.943

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622403: <i>Flight Controls and Pilot-Vehicle Interface</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continue to conduct modeling and simulation efforts to evaluate emerging flight control technologies and concepts, as well as assess mission-level performance of integrated air systems. Continue technology analyses of unmanned air systems in manned/unmanned airspace and airbase operations. Refine trade studies of vehicle concepts for strike, mobility, and reconnaissance. Decrease in FY 2013 due to higher Department of Defense priorities.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	38.321	39.295	36.189	-	36.189

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
Not Applicable.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622404: <i>Aeromechanics and Integration</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622404: <i>Aeromechanics and Integration</i>	59.022	61.217	42.509	-	42.509	46.886	50.213	51.078	55.363	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops aerodynamic configurations of a broad range of revolutionary, affordable aerospace vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and remotely piloted aircraft.

**FY 2011 Accomplishments:**

Continued to perform mission assessments of aerospace platforms for current and future missions including tactical surveillance and weapon delivery. Continued development of technologies for improved weapon delivery and propulsion system performance. Continued development of innovative aerodynamic control methods for small remotely piloted aircraft.

**FY 2012 Plans:**

Continue to develop and assess aeronautical technologies that enable broad use of unmanned aircraft. Continue work to develop and demonstrate flow control to enable fluidic thrust vectoring, area control, and thermal management for a remotely piloted aircraft exhaust nozzle. Continue development of innovative aerodynamic control methods for small remotely piloted aircraft.

**FY 2013 Base Plans:**

Continue to develop and assess aeronautical technologies that enable broad use of unmanned aircraft. Continue work to develop and demonstrate flow control to enable unsteady load suppression, fluidic thrust vectoring, area control, and thermal management for a remotely piloted aircraft. Continue development of innovative aerodynamic control methods for remotely piloted aircraft. Note: In FY 2013, efforts in this thrust are increased due to higher AF priorities.

**FY 2013 OCO Plans:**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	1.819	3.517	10.550	-	10.550

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>		<b>PROJECT</b> 622404: <i>Aeromechanics and Integration</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thurst 2.					
<b>Description:</b> Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for sustained high-speed re-useable high altitude vehicle efforts.					
<b>FY 2011 Accomplishments:</b> Continued development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high-speed propulsion concepts. Continued efforts for high performance high-speed mixed compression inlet concepts utilizing advanced flow control technologies for Mach 3+ expendable systems. Developed and tested inlet variable geometry concepts.					
<b>FY 2012 Plans:</b> Continue development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high-speed propulsion concepts. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment.					
<b>FY 2013 Base Plans:</b> Continue to develop technologies to enable high speed flight. Continue development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high speed propulsion concepts. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	27.016	27.630	7.476	-	7.476
	2.533	2.534	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>		<b>PROJECT</b> 622404: <i>Aeromechanics and Integration</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Continued development of combined flow control and adaptive optics systems to optimize directed energy system performance on large, low-speed aircraft. Initiated development of combined flow control and adaptive optics systems for transonic/supersonic aircraft.					
<b>FY 2012 Plans:</b> Continue work to apply advanced analysis tools to predict the performance of flow control and adaptive optics systems for problems of interest to the Air Force. Extend development of analysis tools for prediction of advanced flow control and adaptive optics to higher speed transonic/supersonic flows.					
<b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Develop and assess technologies for the next generation of multi-role large aircraft.					
<b>FY 2011 Accomplishments:</b> Continued to develop technologies that enable multiple roles and missions for delivery and support aircraft. Conducted wind tunnel experiments to show the feasibility of mobility aircraft using 40% less energy through the use of natural and artificial laminar boundary layers, alternative fuels and very high bypass propulsion integration.					
<b>FY 2012 Plans:</b> Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft. Conduct wind tunnel experiments to show the feasibility of mobility aircraft using 40% less energy through the use of natural and artificial laminar boundary layers, alternative fuels, and very high bypass propulsion integration.					
<b>FY 2013 Base Plans:</b> Continue to develop aerodynamic and propulsion integration technologies that enable multiple roles and missions for delivery and support aircraft. Conduct analyses and experiments to investigate flow control for suppression of unsteady flow and enhanced drag reduction, and to enhance platform performance with integrated propulsion. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b>					
	27.654	27.536	24.483	-	24.483



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>	<b>PROJECT</b> 622404: <i>Aeromechanics and Integration</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	59.022	61.217	42.509	-	42.509

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
Not Applicable.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	89.862	86.663	89.319	-	89.319	92.192	94.813	97.738	99.372	Continuing	Continuing
621123: <i>Learning and Organizational Collaboration</i>	14.174	13.745	13.517	-	13.517	13.329	13.306	13.588	13.984	Continuing	Continuing
625328: <i>Human Dynamics Evaluation</i>	14.494	15.229	22.467	-	22.467	25.785	26.762	28.031	27.991	Continuing	Continuing
625329: <i>Sensory Evaluation and Decision Science</i>	24.634	23.471	32.037	-	32.037	30.468	31.739	31.875	32.529	Continuing	Continuing
627184: <i>Performance Evaluation in Extreme Environments</i>	20.736	17.016	-	-	-	-	-	-	-	Continuing	Continuing
627757: <i>Directed Energy Bioeffects</i>	15.824	17.202	21.298	-	21.298	22.610	23.006	24.244	24.868	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program conducts applied research in the area of airmen training, airmen system interfaces, directed energy bioeffects, deployment and sustainment of airmen in extreme environments, and understanding and shaping adversarial behavior. The Learning and Organizational Collaboration project conducts research to measure, accelerate, and expand the cognitive skills necessary to improve airmen training and mission performance. The Human Dynamics Evaluation project conducts research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. The Sensory Evaluation and Decision Science project conducts research to revolutionize the manner in which the human optimizes the capabilities of Air Force systems, including remotely piloted aircraft (RPA) and adaptive teams of humans and machines. The Performance Evaluation in Extreme Environments project conducts research to enhance human sensory, cognitive, and physical capabilities to increase airmen survivability and performance. The Directed Energy Bioeffects project conducts research on the effects of human exposure to electromagnetic energy (radio frequency to optical), scalable directed energy weapons, and non-lethal weapons. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>
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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	87.452	86.663	86.109	-	86.109
Current President's Budget	89.862	86.663	89.319	-	89.319
Total Adjustments	2.410	-	3.210	-	3.210
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	4.250	-			
• SBIR/STTR Transfer	-0.828	-			
• Other Adjustments	-1.012	-	3.210	-	3.210

**Change Summary Explanation**

FY11: Other Adjustments include -1.012 Congressional General Reductions

FY13: Increase due to Higher Air Force Priorities in Human Dynamics, Sensory Evaluation and Decision Science, and Directed Energy Bioeffects

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 621123: <i>Learning and Organizational Collaboration</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
621123: <i>Learning and Organizational Collaboration</i>	14.174	13.745	13.517	-	13.517	13.329	13.306	13.588	13.984	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project conducts applied research to measure, accelerate, and expand the cognitive skills necessary to improve airmen training and mission performance. Research is conducted in two focus areas: continuous learning and aiding and cognitive and behavioral modeling. The continuous learning and aiding effort creates live, virtual, and constructive (LVC) decision-making environments for use in developing revolutionary simulation technologies to increase training capabilities as well as enhances training effectiveness and efficiency by using learning theory to improve military training and mission performance. Cognitive and behavioral modeling creates realistic models and simulations of human behavior to advance the understanding of how people perform complex tasks.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Research enhances Distributed Mission Operations (DMO) and decision dominance environments and identifies technology requirements for aircrew training in live and immersive environments. Continuous learning/aiding strategies improve personnel selection, mission training, command and control (C2), intelligence, surveillance, and reconnaissance (ISR), and unmanned and cyber missions.</p> <p><b>FY 2011 Accomplishments:</b> Completed analysis of simulation requirements for air-to-ground and air-to-air force training. Utilized results to address specific training requirements for current and future Air Force fighter platforms. Applied sensory-driven decision-making models to broader range of Air Force mission areas. Evaluated analysis of modeling and simulation efforts for enhanced training. Completed evaluation of real-time data insertion capabilities into DMO. Validated methods for identifying common learning requirements for teams. Validated adaptation methods that function in both learning and operational environments and at the coalition level of interaction. Developed and evaluated alternative approaches to model human performance. Developed alternative data aggregation and reporting methods for analyzing mission performance and used these methods to enhance personnel selection, learning, and training. Evaluated these alternative methods for their effectiveness in supporting adaptive readiness training for individuals, teams, and teams-of teams. Began validating approaches for LVC training and performance across tactical, operational, and strategic contexts.</p> <p><b>FY 2012 Plans:</b></p>	10.735	9.762	10.027	-	10.027

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		<b>PROJECT</b> 621123: <i>Learning and Organizational Collaboration</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Develop technology that represents accurate training scenario across multiple security levels in live, virtual, constructive environments. Develop common tools to define scenario and content compatible with different training and operational environments. Demonstrate alternative models for human performance assessment and predictions into a LVC event. Complete validation of fidelity analysis methods and models for use in indentifying alternative training and operational environment characteristics. Develop learning management tools for use in LVC contexts. Demonstrate mission performance-based after action review tools. Complete documentation of joint and multi-national best practices for RPA personnel selection, placement, and training. Demonstrate persistent training and operations event tracking for individual and small team proficiency and squadron readiness assessment.					
<b>FY 2013 Base Plans:</b> Develop methods to manage mission performance data across LVC contexts. Develop technology solution tools to monitor the credibility of virtual and constructive players to augment live operational training and rehearsal. Integrate manned and unmanned DMO systems in common training scenarios. Develop scenarios for cyber team training in a Red Flag exercise environment. Develop after action review and analysis tools for C2, ISR, and Cyber team training.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Cognitive/behavioral modeling explores application of cognitive science for performance improvement by enhancing training in mission-relevant environments (e.g., flight simulators).					
<b>FY 2011 Accomplishments:</b> Integrated mission-relevant task model with language comprehension and generation capability to improve situational awareness of computer-generated teammates. Conducted empirical studies with skill acquisition/retention models and demonstrate ability to produce optimized training and rehearsal programs. Developed graphical user interface for performance prediction systems.					
<b>FY 2012 Plans:</b> Improve human behavior representation in synthetic teammates by incorporating prediction intervals, enhanced knowledge base, and decision heuristics.					
<b>FY 2013 Base Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	3.439	3.983	3.490	-	3.490

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Identify and validate mechanisms to explain and predict human cognitive performance to make performance augmentation. Develop technologies that facilitate model development for applications that are complex, dynamic, and require orders of magnitude more knowledge than tradition cognitive models for laboratory tasks. Investigate potential application to manpower and personnel selection and training.  <i>FY 2013 OCO Plans:</i> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	14.174	13.745	13.517	-	13.517

<b>C. Other Program Funding Summary (\$ in Millions)</b>												
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				PE 0602202F: <i>Human Effectiveness Applied Research</i>				625328: <i>Human Dynamics Evaluation</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
625328: <i>Human Dynamics Evaluation</i>	14.494	15.229	22.467	-	22.467	25.785	26.762	28.031	27.991	Continuing	Continuing

**Note**

Note: In FY 2013, Measurement and Signature Intelligence (MASINT) moves from Project 627184 to this Project to better align the efforts.

**A. Mission Description and Budget Item Justification**

This project conducts applied research to advance machine intelligence, information operations, and operator-aiding technologies for advanced intelligence, surveillance, and reconnaissance (ISR) capabilities. It develops and applies science and technology to detect and exploit a variety of human-centered signatures, including behavioral, nano, bio, and molecular aspects of existing and emerging adversaries. Research is focused in the following areas: 1) Human Signatures - Discover, characterize, and integrate signature information to enable rapid and accurate human MASINT; 2) Patterns of Life - The study of relevant human threat and vulnerability patterns in context of everyday life and understand human interaction with autonomous systems; 3) Human Analyst Augmentation - Develop, integrate, and evaluate human-centric analyst technology solutions, such as adversarial modeling and cross-cultural communication, leading to more operationally effective ISR for the Air Force.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Identify methods to enhance mission-essential human capabilities for cyber operations. Develop measures of effectiveness for cyber capabilities.</p> <p><b>FY 2011 Accomplishments:</b> Continued conducting research to enhance performance and increase situational awareness within cyber operations, including operations support center environments. Developed quantifiable measures of effectiveness to demonstrate ability to effectively anticipate and influence the behavior of adversaries. Continued foundational studies toward enhancing cognitive cyber performance.</p> <p><b>FY 2012 Plans:</b> Continue conducting research into enhancing cognitive cyber performance. Develop technologies that increase situational awareness within cyber operations and research metrics to accurately assess attacks from adversaries.</p> <p><b>FY 2013 Base Plans:</b> N/A</p>	3.503	1.888	-	-	-



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		<b>PROJECT</b> 625328: <i>Human Dynamics Evaluation</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Note: This effort ends in FY 2012 due to higher Air Force priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Conduct research to enhance human components of ISR. Develop ability to anticipate, influence, and dominate adversary's air, space, and cyber ISR systems, processes, and organizations.					
<b>FY 2011 Accomplishments:</b> Conducted research to enable human operators to maximize utility of multi sensor ISR systems in planning for dynamic situations. Conducted research to develop distributed, collaborative ISR dynamic planning capabilities for intelligence analysts.					
<b>FY 2012 Plans:</b> Develop framework and knowledge-based foundation for intelligence analysis. Conduct studies and incorporate feedback from the intelligence community to enhance methodologies for exploiting unstructured and cognitively complex data and information.					
<b>FY 2013 Base Plans:</b> Develop new multi-intelligence analysis concepts and prototypes based upon analyst evaluations. Conduct studies to evaluate new prototypes for signature, patterns, and other exploited intelligence data to augment analysis effectiveness.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3					
<b>Description:</b> Conduct research to develop technology base for anticipatory command and control intelligence (C2I) decision support. Conduct research in cross cultural communications and automated speech translation tools for Air Force missions. Develop models/metrics to predict/evaluate organizational effectiveness alignment and collaboration readiness.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	2.222	4.061	3.075	-	3.075
	7.915	9.280	9.524	-	9.524

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012						
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		<b>PROJECT</b> 625328: <i>Human Dynamics Evaluation</i>						
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>										
<p>Researched ability of models to simulate enemy potential courses of action, including complex adversarial behavior. Explored the feasibility to integrate models within visual displays. Developed adversarial cultural modeling techniques to gauge adversarial threats. Developed advanced models/simulation to demonstrate measures of effectiveness for selected influence operations capabilities. Researched foreign language speech-to-speech translation applications that support automated, cross cultural communications. Developed foundational decision aid concepts to exploit operator human-human trust and trust in automation for influence operators. Matured research on organizational effectiveness to support organizational change in government domains. Developed advanced models/simulations to show the impact of improved work design, engaged organizational culture, and enhanced collaboration readiness.</p> <p><b>FY 2012 Plans:</b> Develop methods to enhance an analyst's ability to assess possible threats as a logical consequence of observed human and organizational behavior. Begin integration of cognitive modeling architectures and cultural modeling techniques to initiate framework for estimating adversary intent and possible courses of action. Continue conducting foreign language speech-to-speech translation applications that support automated, cross cultural communications. Continue to refine and expand advanced, automated algorithms for measures of effectiveness analyses supporting improved influence operations capabilities. Develop methods applicable to theaters of operation that enhance warfighter situational awareness of adversarial location, intent, and predictability of hostile action. Continue research and development on decision aid concepts to exploit operator human-human trust and trust in automation. Conduct trust-based experimentation, discourse analysis and building vulnerability modeling tools. Complete organizational vulnerabilities research; illustrate and document modes/simulations that show the impact of improved work design, engaged organizational culture and enhanced collaboration readiness.</p> <p><b>FY 2013 Base Plans:</b> Explore multi-cultural potential avenues of influence and develop adversary effects models and simulations. Develop tools, algorithms, and techniques for rapid development of speech recognition, machine translation, and natural language processing components in new languages and domains. Develop methods for speech recognition and translation of previously unencountered words in languages that have complex prefix and suffix structures in order to improve threat warning. Explore methods and develop theories for quantification of trust between people and real-time metrics of human trust of automation.</p> <p><b>FY 2013 OCO Plans:</b></p>						<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 625328: <i>Human Dynamics Evaluation</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<p><b>Title:</b> Major Thrust 4</p> <p><b>Description:</b> Conduct applied research in the areas of mathematics and electromagnetic theory to exploit/counter adversarial capabilities.</p> <p><b>FY 2011 Accomplishments:</b> Refined advanced, automated algorithms for measures of effectiveness analyses supporting improved influence operations capabilities. Developed methods to enhance warfighter situational awareness of adversarial location and intent.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p>Note: In FY12, this effort was combined with the Influence Operations effort in this Project due to Project realignment.</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	0.854	-	-	-	-
<p><b>Title:</b> Major Thrust 5</p> <p><b>Description:</b> Develop databases of human motion and features collected from air/space platforms. Identify human threat signatures across diverse populations for ISR and force protection applications. Conduct surveillance and counterproliferation research to support detection, identification, and assessment of threat agents in support of Air Force operational missions.</p> <p>Note: In FY 2013, two efforts from Project 627184 realign into this effort for better alignment.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b></p>	-	-	9.868	-	9.868

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 625328: <i>Human Dynamics Evaluation</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b><i>FY 2013 Base Plans:</i></b> Develop architectures for machine-intelligent biofidelic human threat models. Develop human motion/shape information system and online analytic tools for automatic detection and tracking of humans, discernment of gender, and detection of human shape anomalies. Develop nano-bio technologies and sensor components to detect target molecules of interest in the operational environment. Develop analysis tools to identify and track molecular-based threat signatures. Characterize and exploit human signatures to perform ISR mission tagging, tracking, and locating of threats.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	14.494	15.229	22.467	-	22.467

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 625329: <i>Sensory Evaluation and Decision Science</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
625329: <i>Sensory Evaluation and Decision Science</i>	24.634	23.471	32.037	-	32.037	30.468	31.739	31.875	32.529	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project conducts applied research to revolutionize the manner in which the human optimizes the capabilities of Air Force systems, including RPA and adaptive teams of humans and machines. Research optimizes human situational awareness and cognitive performance, improves the human-machine interface, and seamlessly integrates warfighters with their weapon systems across air, space, and cyber domains. Research is conducted in four focus areas: applied neuroscience; supervisory control; battlespace visualization; and battlespace acoustics. The applied neuroscience area develops technologies to enhance human-human and human-machine collaborations and system interactions in distributed decision-making environments. The supervisory control area develops new control/display concepts and technologies to optimize Air Force platform capabilities. The battlespace visualization area advances the science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. The battlespace acoustics area researches human-human and human-machine communications to exploit the use of voice and acoustic data in collaborative, net-centric environments while accounting for the effects of acoustic propagation.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develops technologies to enhance human performance, human-human and human machine collaboration, and system interaction in distributed decision-making environments.</p> <p><b>FY 2011 Accomplishments:</b> Investigated teams-of-teams performance metrics and begin to explore the nature of teams-of-teams cognitive workload so that future development of adaptive aiding algorithms shape team situational awareness in a network-centric environment. Investigated algorithms that assess team cognitive workload independent of the workload of individual operators. Began to develop adaptive interface algorithms for operator decision aiding.</p> <p><b>FY 2012 Plans:</b> Develop team functional state assessment criteria and characterize context dependent methodologies for assessing the cognitive functional state of teams. Explore algorithm utility for assessing real-time team functional state in distributed operations. Evaluate ability to capture team functional state assessments to enhance collaboration and team decision-making. Develop adaptive interface algorithms for operator decision aiding.</p> <p><b>FY 2013 Base Plans:</b></p>	5.408	5.582	8.387	-	8.387

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		<b>PROJECT</b> 625329: <i>Sensory Evaluation and Decision Science</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Explore the development of trust metrics that can be used to design and enable trust automation for operators. Develop the framework for modeling physiological and behavioral workload on the human operator. Develop adaptive algorithms for workload management and mitigation. Evaluate utility of workload assessment tool for teams. Investigate potential tools for enhancing warfighter cognitive resiliency and performance through the manipulation of intrinsic biological and physiological mechanisms and processes. Define metrics and biomarkers of resiliency and performance that can be integrated into these tools for sensing and assessing cognitive state.					
Note: In FY 2013, an effort from Project 627184 merges with this effort for better alignment.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Research new control/display concepts and technologies (e.g., information portrayal, control devices, and decision aiding algorithms). Identify best design to direct operator attention.					
<b>FY 2011 Accomplishments:</b> Evaluated the utility of 3-D information displays, multi-sensory interfaces, and other virtual reality technologies for multi-RPA supervisory control. Generated intuitive ways to monitor, interact, and coordinate with complex, intelligent RPA automation algorithms. Identified predictive information displays, including temporal displays that furnish proactive decision support to the human operator in multi-RPA scenarios. Investigated unique facets of automation, such as social attributes, that may improve the overall RPA human-system bandwidth.					
<b>FY 2012 Plans:</b> Explore flexible automation techniques and transitions to enable a human operator to intervene at various levels with autonomous systems. Develop methods to quickly and easily ascertain the status/intent of complex automation. Design and evaluate methods and interfaces to support distributed, ubiquitous unmanned system control of many heterogeneous systems. Investigate combined spatial and temporal displays for proactive management of multiple semi-autonomous assets.					
<b>FY 2013 Base Plans:</b> Identify human operator-RPA automation interaction technologies and techniques that will provide increased situational awareness while exercising supervisory control of multiple RPAs. Investigate and develop course-of-action tools, displays, and system software architectures that will support an operator's choice between several					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	6.732	6.422	6.921	-	6.921

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
courses of action. Explore the use of adaptive automation for teams of RPAs/RPA operators to enable real-time situation awareness of human and vehicle states. Develop an agent information architecture that responds to RPA pilot information queries by gathering, fusing and presenting information from on and off board sources.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3					
<b>Description:</b> Battlespace visualization advances science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making.					
<b>FY 2011 Accomplishments:</b> Explored vision enhancement techniques that can support the air, space, and cyber analysts' ability to quickly categorize objects of interest. Performed laboratory evaluations of visualizations that support human knowledge when presented with complex information in the air, space, and cyber domains. Developed visualizations and interaction techniques to exploit dynamic information. Developed situational awareness presentation and interface technologies that increase warfighter knowledge.					
<b>FY 2012 Plans:</b> Explore vision enhancement techniques for fusing multi-source data to facilitate decision making. Develop interactive visualizations for displaying and analyzing multi-source information to improve situational awareness. Investigate visual analytics to optimally represent relevant information from large and disparate data sets. Develop initial visualizations to represent and analyze large amounts of data to increase human performance.					
<b>FY 2013 Base Plans:</b> Assess human perception and performance of fused, multi-source information. Develop visualizations using visual analytics for representing information from large, disparate data sets. Extend visualization techniques to three-dimensional displays. Assess the effectiveness of interactive visualizations to augment human operator situation awareness.					
Note: This effort increases in FY 2013 due to increased emphasis in this area.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4					
	6.539	5.857	8.306	-	8.306
	5.955	5.610	6.923	-	6.923

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		<b>PROJECT</b> 625329: <i>Sensory Evaluation and Decision Science</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
<b>Description:</b> Conducts battlespace acoustics research on advanced auditory and communication technologies that mitigate effects of noise and enhance performance in operational environments.					
<b>FY 2011 Accomplishments:</b> Evaluated the use of multi-modal speech displays to optimize distributed team performance in large-scale communication networks. Conducted research on immersive audio and multi-modal interfaces for exploiting large-scale networks of distributed information and enhancing real-time situational awareness and time-critical decision effectiveness. Explored integrated multi-sensory display concepts to optimize the flow of information across distributed teams, emphasizing how intuitive displays can promote shared situational awareness between command, control, intelligence, surveillance, and reconnaissance assets and operators.					
<b>FY 2012 Plans:</b> Explore the application of multi-modal digital communication technologies to enhance speech intelligibility, communication effectiveness, and situational awareness in communication-intense military environments. Explore the use of accelerated speech to enhance situational awareness and communication effectiveness. Assess integration of graphical images with speech and text communication to enhance operator situational awareness and understanding. Evaluate and monitor operator stress and workload using verbal communication signals.					
<b>FY 2013 Base Plans:</b> Explore how best to use multi-modal and networked communications to fight through cyber attacks in defensive cyber operations with a focus on the human interface. Investigate human interface concepts that disrupt communication effectiveness across networked command and control teams for offensive cyber operations. Explore the use of advanced multi-modal interfaces to aid combat search and rescue teams in simulated scenarios. Assess the effectiveness of spatial audio display concepts combined with vibro-tactile displays and enhanced visual displays to augment individual and team performance.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 5					
<b>Description:</b> Predict physiological impacts of high stress/extreme environments.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	-	-	1.500	-	1.500



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 625329: <i>Sensory Evaluation and Decision Science</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> Develop physiology modeling and sensing capability to measure stress parameters and predict physiological impacts of high stress/extreme environments.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	24.634	23.471	32.037	-	32.037

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>				<b>PROJECT</b> 627184: <i>Performance Evaluation in Extreme Environments</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
627184: <i>Performance Evaluation in Extreme Environments</i>	20.736	17.016	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2013, the efforts in this Project move into Projects 625328, 625329, and 627757 to better align the efforts.

**A. Mission Description and Budget Item Justification**

This project conducts applied research to enhance human sensory, cognitive, and physical capabilities to increase airmen survivability and performance. The research is focused in four areas: biobehavioral performance; biomechanics; applied biotechnology; and counterproliferation. Both biobehavioral and biomechanics focus areas enhance airmen performance and survivability through dynamic human modeling techniques that define the capabilities and limits of system operators under military-unique stressors, as well as assessing and identifying adversarial threats. Applied biotechnology advances bioscience, nanotoxicology, and neuroscience research to protect airmen from the effects of toxic chemicals and materials, and to monitor and enhance cognitive and physiological performance. Counterproliferation research focuses on biotechnology for the detection, identification, monitoring, and neutralization of biological threat agents.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop databases of human motion and features collected from air/space platforms. Identify human threat signatures across diverse populations for ISR and force protection applications.</p> <p><b>FY 2011 Accomplishments:</b> Developed anthropometry and motion database ontology to exploit human threat signatures. Completed development and validate techniques to identify human motion that seem out-of-context as viewed from Air Force sensors. Developed models that include cultural information to detect anomalies in both behavior and expressions.</p> <p><b>FY 2012 Plans:</b> Initiate 3-D human activity replication using 3-D human models. Develop a human motion repository to identify human threat and performance signatures. Develop tools for image analyst training that identify and visualize critical threat indicating signatures.</p> <p><b>FY 2013 Base Plans:</b> N/A</p>	5.555	3.244	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Note: In FY 2013, this effort moves into Project 625328 to better align efforts.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Define and model operator cognitive performance in stressful environments and develop technologies to mitigate effects of stressors on cognitive function, safety, and mission effectiveness.					
<b>FY 2011 Accomplishments:</b> Developed biological, behavioral, and physical metrics and markers of cognitive performance. Delineated mechanisms that affect warfighter (e.g., battlefield airmen and RPA operators) cognitive and physical performance.					
<b>FY 2012 Plans:</b> Define stressor-influenced mechanisms for developing strategies to optimize cognitive readiness and to influence performance in theater. Target specific biological, behavioral, and physical metrics and markers for defining mechanisms that improve cognitive performance.					
<b>FY 2013 Base Plans:</b> N/A					
Note: In FY 2013, this effort moves into Project 625329 to better align efforts.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3					
<b>Description:</b> Conduct bio/nanotechnology research to advance warfighter performance. Leverage toxicological/biological data to improve human performance and decision-making abilities.					
<b>FY 2011 Accomplishments:</b>					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	3.482	5.223	-	-	-
	5.929	3.592	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Advanced toxicity research associated with Air Force relevant nanomaterials and conduct toxicity assessments of biofuels of Air Force interest. Continued to identify molecular markers that enhance human performance. Continued to investigate cell-based pathways.					
<b>FY 2012 Plans:</b> Pursue advanced analysis of new and emerging nanomaterials and biofuels of Air Force interest. Validate molecular markers in specific cognitive and physiological pathways that impact human performance.					
<b>FY 2013 Base Plans:</b> N/A					
Note: In FY 2013, this effort moves into Project 627757 to better align efforts.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4					
<b>Description:</b> Conduct surveillance and counterproliferation research to support detection, identification, and assessment of threat agents in support of Air Force operational missions.					
<b>FY 2011 Accomplishments:</b> Completed techniques to effectively neutralize threat agents. Used bioinspired approaches to expand and refine nanoparticle taggants research.					
<b>FY 2012 Plans:</b> Develop and incorporate bioinspired nanoparticle taggants for enhanced warfighter counterproliferation capability during operational missions. Identify biological markers that indicate that individuals have handled, transported, or manipulated weapons of mass destruction.					
<b>FY 2013 Base Plans:</b> N/A					
Note: In FY 2013, this effort moves into Project 625328 to better align efforts.					
<b>FY 2013 OCO Plans:</b>					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	5.770	4.957	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 627184: <i>Performance Evaluation in Extreme Environments</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	20.736	17.016	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 627757: <i>Directed Energy Bioeffects</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
627757: <i>Directed Energy Bioeffects</i>	15.824	17.202	21.298	-	21.298	22.610	23.006	24.244	24.868	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project conducts applied research on the effects of human exposure to electromagnetic (EM) energy (radio frequency to optical), scalable directed energy weapons, and non-lethal weapons. This research addresses fundamental physical principles, as well as the psychophysical interaction between directed energy and the individual or groups of individuals. Research is divided into three core focus areas: optical radiation bioeffects; radio frequency radiation (RFR) bioeffects; and biobehavioral systems. Optical radiation bioeffects research enhances combat survivability and systems effectiveness through technologies that enable deployed forces to counter optical threats and exploit optical systems for offensive applications. The RFR bioeffects research focuses on theoretical and empirical dosimetry, bioeffects of short-and long-term exposures, methods to counter RFR threats, and exploitation of directed energy systems for offensive capabilities. Applied biotechnology advances bioscience, nanotoxicology, and neuroscience research to protect airmen from the effects of toxic chemicals and materials to monitor and enhance cognitive and physiological performance.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Conduct laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology, while providing countermeasures for optical hazards/threats.

**FY 2011 Accomplishments:**

Conducted research to refine Department of Defense, national, and international safe exposure standards to include multiple wavelength laser exposures. Initiated research to provide personal protection while operating in a high energy directed energy weapon hazard zones. Validated collateral hazard assessment software for high energy laser systems and weapon platforms.

**FY 2012 Plans:**

Begin developing tools to assess collateral high energy laser hazards using probabilistic techniques. Develop new models and techniques for assessing vision effects from laser eye protection. Assess human factors integration of laser eye protection with visor, helmet, and advanced cockpit designs. Continue research on advanced designs of personal protection in high energy directed energy weapons hazard zones.

**FY 2013 Base Plans:**

Develop high power probabilistic range safety tools for predicting eye and skin hazard zones from high energy laser weapon systems. Develop models and methods for unique approaches using optical radiation for future

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	7.660	7.854	8.128	-	8.128

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		<b>PROJECT</b> 627757: <i>Directed Energy Bioeffects</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
weapon systems with scalable, disruptive, and ultra-precise effects. Develop parameters for optimizing laser vision effect models for advanced laser eye protection models and non-lethal weapons.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Conduct laboratory experiments and field research to enable safe exploitation of directed energy technologies for communication, target identification, and weapons development.					
<b>FY 2011 Accomplishments:</b> Conducted terahertz research in order to refine national and international safe exposure levels and evaluate potential military utility. Conducted bioeffects research to support scalable directed energy weapon capabilities. Initiated development of a model of scalable RFR effects based on experimentation and theoretical physics. Assessed combinations of directed energy parameters on behavior and physiology.					
<b>FY 2012 Plans:</b> Conduct electromagnetic radiation bioeffects research in support of national and international safety standards. Conduct biological studies of advanced directed energy weapon concepts. Conduct physiological and behavioral research to support scalable directed energy weapon capabilities. Continue scalable RFR effects modeling development based on theoretical and experimental physics. Assess bioeffects of combined directed energy sources.					
<b>FY 2013 Base Plans:</b> Integrate basic mechanisms of interactions between biology and RF radiation for validation of bioeffects models from ultra-short, high peak power, RF systems. Continue investigating terahertz (THz) radiation effects on cells and tissues and improve bioeffects models for exposure; initiate proposals for refined exposure standards for THz radiation. Continue assessing combined biological effects from multiple, combined directed energy sources.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3					
	7.781	8.388	8.111	-	8.111
	0.383	0.960	5.059	-	5.059

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 627757: <i>Directed Energy Bioeffects</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Concentrate on human responses to non-lethal weapons and conduct research to assess the effects and risk of these weapons. Conduct bio/nanotechnology research to advance warfighter performance. Leverage toxicological/biological data to improve human performance and decision-making abilities.</p> <p><b>FY 2011 Accomplishments:</b> Developed initial quantitative models of behavioral responses using effects data from directed energy non-lethal weapons. Enhanced Human Effect - Modeling Applications Program (HE-MAP) through addition of a software interface linking HE-MAP graphical user interfaces with predictive models of acoustic non-lethal weapon-induced effectiveness and risk. Incorporated within HE-MAP the development of an effects-based design module that will allow analysis of design parameters of directed energy non-lethal weapons and their influence on effectiveness.</p> <p><b>FY 2012 Plans:</b> Develop a quantitative framework for relating directed energy and scalable novel-effects technologies (including non-lethal and escalation of force weapons) to operationally relevant outcomes via research on physiological and psychological HE. Establish a database containing behavioral effectiveness and risk of injury information under operational conditions to facilitate coordination among operators, researchers, and weapon acquisition professionals. Develop methodology to quantify behavioral effectiveness (e.g., sensory, cognitive, motor) across the range of directed energy and scalable novel-effects technologies. Develop methodology to quantify the risk of injury (e.g., reversible, irreversible) across the range of non-lethal and escalation of force weapons.</p> <p><b>FY 2013 Base Plans:</b> Continue expanding the quantitative framework for relating directed energy and scalable novel-effects technologies to operationally relevant mission outcomes. Continue expanding the knowledge base of behavioral effectiveness and risk of injury under operational conditions to facilitate non-lethal weapons wargaming and acquisition. Advance toxicity and nanotoxicity research; investigate/establish toxicity impacts to the body of advanced fuels, materials, and chemicals used to support existing and future weapon systems. Define and pursue modulation of major cell pathways affecting cognition using in vitro and in vivo models and modeling.</p> <p>Note: In FY 2013, an effort in Project 627184 merges with this effort for better alignment.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	15.824	17.202	21.298	-	21.298



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>	<b>PROJECT</b> 627757: <i>Directed Energy Bioeffects</i>

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>			<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u>	
			<u>Base</u>	<u>OCO</u>	<u>Total</u>					<u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	198.878	207.406	232.547	-	232.547	200.918	165.900	168.511	177.525	Continuing	Continuing
623012: <i>Advanced Propulsion Technology</i>	22.074	20.367	23.637	-	23.637	23.345	22.160	24.276	27.254	Continuing	Continuing
623048: <i>Combustion and Mechanical Systems</i>	17.734	20.069	15.874	-	15.874	13.886	12.744	12.829	13.103	Continuing	Continuing
623066: <i>Turbine Engine Technology</i>	64.278	67.702	102.188	-	102.188	75.523	42.355	42.628	43.520	Continuing	Continuing
623145: <i>Aerospace Power Technology</i>	31.346	32.639	30.061	-	30.061	27.801	28.677	28.739	28.848	Continuing	Continuing
624847: <i>Rocket Propulsion Technology</i>	56.966	60.390	55.293	-	55.293	54.888	54.689	54.727	59.374	Continuing	Continuing
625330: <i>Aerospace Fuel Technology</i>	6.480	6.239	5.494	-	5.494	5.475	5.275	5.312	5.426	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has six projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology project develops high-speed air breathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Air Force. The Combustion and Mechanical Systems project evaluates lubricants and combustion concepts and technologies for new and existing engines. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems and develops component technologies for ultra high pressure ratio, substantially improved durability, and adaptive cycle engine architecture to provide optimized performance, fuel efficiency, and life for widely varying mission needs. The Aerospace Power Technology project develops electrical power and thermal management technologies for military applications that are part of energy optimized aircraft development. The Rocket Propulsion Technology project develops advances in rocket propulsion technologies for space access, space maneuver, missiles, the sustainment of strategic systems, and tactical rockets. The Aerospace Fuel Technology project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation, and combined-cycle engines. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>				
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i>	PE 0602203F: <i>Aerospace Propulsion</i>				
BA 2: <i>Applied Research</i>					

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	207.049	207.508	204.967	-	204.967
Current President's Budget	198.878	207.406	232.547	-	232.547
Total Adjustments	-8.171	-0.102	27.580	-	27.580
• Congressional General Reductions	-	-0.102			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.474	-			
• Other Adjustments	-4.697	-	27.580	-	27.580

**Change Summary Explanation**

FY11: Other Adjustments include -1.697 Congressional General Reductions and -3.000 Congressional Directed Reductions

FY13: Increase due to higher Air Force priorities in Turbine Engine Technology

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 623012: <i>Advanced Propulsion Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
623012: <i>Advanced Propulsion Technology</i>	22.074	20.367	23.637	-	23.637	23.345	22.160	24.276	27.254	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops combined/advanced cycle air breathing high-speed (up to Mach 4) and hypersonic (Mach 4 to 8+) propulsion technologies to provide revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed/hypersonic weapons and aircraft concepts. The primary focus is on hydrocarbon-fueled engines capable of operating over a broad range of flight Mach numbers. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future warfighter needs.

**FY 2011 Accomplishments:**

Developed and demonstrated flight weight engine components and advanced engine control logic. Assessed advanced instrumentation with control logic to improve scramjet operability. Performed trajectory optimization for flight test. Conducted ground test of advanced scramjet start technique. Completed fabrication of flight test hardware to demonstrate ramjet to scramjet transition.

**FY 2012 Plans:**

Develop and demonstrate advanced engine control systems and flight weight scramjet engine components. Develop and demonstrate closed loop engine control system with advanced instrumentation to increase scramjet engine operability at low scramjet Mach numbers. Conduct flight test using sounding rocket launch to demonstrate transition from ramjet to scramjet.

**FY 2013 Base Plans:**

Continue development and demonstration of advanced engine control systems and flight weight scramjet engine components. Based on prior ground and flight testing, refine and demonstrate closed loop engine control system with advanced instrumentation to increase scramjet engine operability at low scramjet Mach numbers. Conduct direct connect testing of flight weight scramjet components for cold start systems.

**FY 2013 OCO Plans:**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	2.565	1.650	1.650	-	1.650

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		<b>PROJECT</b> 623012: <i>Advanced Propulsion Technology</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Conduct assessments, technology design trades, and simulations to integrate combined cycle engines (CCEs) and air breathing hypersonic propulsion technologies into future systems.					
<b>FY 2011 Accomplishments:</b> Conducted further trade studies to determine military payoff and establish component technology goals. Defined component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with National Aeronautics and Space Administration (NASA) and Defense Advanced Research Projects Agency (DARPA). Developed technology maturation plan, including test facility requirements, for advanced components for turbine-based and rocket-based CCEs.					
<b>FY 2012 Plans:</b> Continue to conduct trade studies to determine military payoff and establish component technology goals. Improve definition of component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Update technology maturation plan, including test facility requirements, for advanced components for turbine-based and rocket-based CCEs.					
<b>FY 2013 Base Plans:</b> Continue to conduct trade studies to determine military payoff and establish component technology goals. Improve definition of component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Update technology maturation plan, including test facility requirements, for advanced components for turbine-based and rocket-based CCEs. Initiate detailed component development roadmapping.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future platforms.					
<b>FY 2011 Accomplishments:</b>					
	0.165	0.165	0.120	-	0.120
	19.344	18.552	21.867	-	21.867

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Developed advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Developed techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Developed low internal drag flame stabilization devices and flight test engine components. Ground tested subscale components/combustors to represent medium scale (5 to 20 times) scramjet engines.					
<b><i>FY 2012 Plans:</i></b> Develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Develop techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Develop low internal drag flame stabilization devices and flight test engine components. Design and initiate fabrication of heavy weight scramjet combustor in medium scale (5 to 20 times) scramjet engines.					
<b><i>FY 2013 Base Plans:</i></b> Continue to develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Continue to develop techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Continue to develop low internal drag flame stabilization devices and flight test engine components. Complete fabrication of heavy weight scramjet combustor in medium scale (5 to 20 times) scramjet engines. Initiate direct connect testing of medium scale (5 to 20 times) scramjet engines operating at Mach 3.5 to Mach 7 conditions.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	22.074	20.367	23.637	-	23.637

**C. Other Program Funding Summary (\$ in Millions)**

Line Item	FY 2011	FY 2012	FY 2013	FY 2013	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Cost To		
			Base	OCO	Total					Complete	Total Cost	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
623048: <i>Combustion and Mechanical Systems</i>	17.734	20.069	15.874	-	15.874	13.886	12.744	12.829	13.103	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project evaluates lubricants, mechanical systems, and combustion concepts for advanced turbine engines, pulse detonation engines, and combined cycle engines. This project also develops technologies to increase turbine engine operational reliability, durability, mission flexibility, maintainability, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, and sustained high-speed vehicles. Analytical and experimental areas of emphasis include lubricants, bearings, mechanical systems diagnostics, mechanical systems prognostics, rotordynamics, oil-less engine technology, optical diagnostics, fundamental combustion, detonations, combustors, and afterburners. Lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Advanced combustion concepts must be cost-effective, durable, and reduce pollutant emissions. A portion of this project supports adaptive cycle technologies. This effort develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop, test, and evaluate revolutionary combustion and propulsion concepts for gas turbine, pulse detonation, and combined cycle engines for missiles, manned and unmanned systems.

**FY 2011 Accomplishments:**

Tested full-scale inter-turbine burner (ITB) concepts at relevant engine conditions. Investigated novel valving concepts for pulse detonation engines. Studied pulse detonation engine-turbine interactions. Explored the use of regenerative fuel cooling with pulse detonation engines and other combustion systems. Demonstrated novel small internal combustion engine concepts that improve system performance. Used advanced modeling and simulation tools to understand combustion processes and to guide combustion system design. Employed new chemistry models for alternative fuels. Tested concept designs for adaptive combustors for ultra efficient turbine engine components which reduce harmful emissions.

**FY 2012 Plans:**

Evaluate alternative fuels in combustion systems at relevant engine conditions. Test full-scale compact combustor concept relevant to highly efficient, embedded turbine engine goals. Demonstrate small-scale propulsion system operation using reduced-octane fuels. Employ new physical models in simulation tools. Investigate pressure gain combustion concepts for application to propulsion systems. Continue studies of pulse

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1.	7.541	8.719	6.202	-	6.202

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 623048: <i>Combustion and Mechanical Systems</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
detonation engine-turbine interactions. Investigate feasibility of rotary detonation engines (RDE) and continuous detonation engines.  <b>FY 2013 Base Plans:</b> Develop new models for combustion processes at high pressure conditions. Test combustion system design that produce low pollutant emissions. Test RDE concepts. Decrease in FY 2013 due to higher Department of Defense priorities.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.  <b>Description:</b> Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.  <b>FY 2011 Accomplishments:</b> Used two-color planar laser induced fluorescence techniques to measure temperature in relevant-environment combustion systems. Developed robust line-of-sight measurement techniques for temperature and species and apply to engine systems. Developed simultaneous high-speed planar laser-induced fluorescence and particle-image velocimetry for measurements of species and velocity fields in practical combustion devices. Expanded line-of-sight measurement techniques for temperature and species to include many simultaneous lines of sight and tomographic reconstruction of complex reacting flowfields characteristic of real-world hardware. Applied advanced optical diagnostics suites for characterization and improvement of engine combustors and afterburners.  <b>FY 2012 Plans:</b> Apply line-of-sight measurement techniques for temperature and species to combustion systems in a relevant engine environment. Demonstrate simultaneous high-speed planar laser-induced fluorescence and particle-image velocimetry for measurements of species and velocity fields in practical combustion devices. Demonstrate tomographic reconstruction of reacting flowfields in relevant combustion systems.  <b>FY 2013 Base Plans:</b>	1.171	1.311	1.128	-	1.128

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 623048: <i>Combustion and Mechanical Systems</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>Apply advanced laser diagnostics and novel optics configurations to high pressure test cell environment. Demonstrate particle image velocimetry in high pressure combustion test apparatus. Investigate high-speed measurement techniques for combustion temperature and species.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop, test, and qualify advanced turbine engine lubricants. Generate and maintain military specifications for aviation engine lubricants.</p> <p><b>FY 2011 Accomplishments:</b> Completed Technology Readiness Level (TRL) 5 full-scale bearing endurance test on second enhanced ester candidate oil in preparation for an engine demonstration. Supported full transition of enhanced ester oil to the operational fleet by coordinating with engine manufacturers and users. Conducted adaptive components for high efficiency risk mitigation bearing and gear rig tests with enhanced ester oil in preparation for 2013 demonstration engine test. Demonstrated anti-coke surface modifiers on sub-scale supersonic lube system components. Expanded development of intelligent prognostics for lubrication system health monitoring. Investigated advanced lube system thermal and health management technologies for highly embedded efficient turbine engines.</p> <p><b>FY 2012 Plans:</b> Demonstrate anti-coke surface modifiers on full-scale lubrication system components. Develop engine mechanical system health management control algorithms for active rotor thrust balancing. Develop suite of technologies for intelligent lube system prognostics and health monitoring, such as integrated debris capture devices, real-time oil debris monitoring, and vibration sensing. Develop lubrication system thermal management technologies for reduced heat generation and improved heat dissipation for efficient turbine engines.</p> <p><b>FY 2013 Base Plans:</b> Demonstrate lube system health management control algorithms with full-scale TRL 5 rig hardware. Test enhanced ester oils in demonstrator turbine engines. Continue investigating advanced lube system thermal management technologies for fuel efficient turbine engines. Develop new oil traction models and validate experimentally.</p> <p><b>FY 2013 OCO Plans:</b></p>	4.463	4.966	4.181	-	4.181

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications.</p> <p><b>FY 2011 Accomplishments:</b> Investigated fatigue life and spall propagation of Vacuum Induction Melted-Vacuum Arc Remelted (VIM-VAR) bearings. Completed mechanical systems risk mitigation test activities for adaptive components for high efficiency. Developed coupled bearing and rotor dynamic models for virtual simulation of mechanical systems for advanced engines. Continued developing reliable bearing technologies for sustained hi-mach reusable and limited-life engines. Completed fabrication of active rotor thrust balance bearing test rig.</p> <p><b>FY 2012 Plans:</b> Conduct shakedown tests of active thrust balance rig. Develop and demonstrate robust thrust load sensing devices for highly loaded engine thrust bearings. Develop bearing spall debris monitoring model and limits and incorporate into thrust load control algorithm. Demonstrate oil debris monitoring technology fused with vibration sensing on seeded fault bearing rig tests. Develop new bearing heat generation models for engines and validate with full-scale bearing experimental performance data.</p> <p><b>FY 2013 Base Plans:</b> Conduct parametric active thrust control experiments to validate load control algorithms. Conduct seeded fault bearing tests to validate reliable active and autonomous thrust load control. Integrate active thrust control, vibration, and oil debris sensing for complete TRL 5 mechanical system health management system. Coordinate plans for demonstrating active thrust control system in future TRL 6 engine demonstration.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	4.559	5.073	4.363	-	4.363
<b>Accomplishments/Planned Programs Subtotals</b>	17.734	20.069	15.874	-	15.874

<b>C. Other Program Funding Summary (\$ in Millions)</b>										
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

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**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 623066: <i>Turbine Engine Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
623066: <i>Turbine Engine Technology</i>	64.278	67.702	102.188	-	102.188	75.523	42.355	42.628	43.520	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, adaptive cycle technologies, and structural design. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs. This project supports joint Department of Defense, agency, and industry efforts to focus turbine propulsion technology on national needs. The program plan is relevant across capability areas for global responsive strike, capable unmanned war-fighting, tactical and global mobility, responsive space lift, and persistent intelligence, surveillance, and reconnaissance (ISR).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.</p> <p><b>FY 2011 Accomplishments:</b> Developed and applied advanced modeling and simulation rules and tools for advanced components. Developed computational fluid dynamics methodology for analyzing turbine flows. Developed ceramic matrix composite lifing models. Conducted bench and rig tests for validation of components with significantly improved efficiency. Performed rig testing of lightweight, simple, adaptive cycle features, an efficient, wide-flow range compressor, an efficient, high temperature turbine capable of operating over large swings in required work, and an efficient, lightweight, low observable (LO)-compatible exhaust system. Developed and applied advanced modeling and simulation rules and tools to initiate definition and design of efficient, very high pressure ratio core component technologies that will offer a step change improvement in engine specific fuel consumption.</p> <p><b>FY 2012 Plans:</b> Develop modeling and simulation rules and tools for advanced components including advanced interactive cost analysis tools for adaptive core components and unsteady aerodynamics/aeromechanics models. Conduct bench and rig tests to validate unsteady aerodynamics/aeromechanics models. Continue rig testing adaptive cycle features, an efficient compressor, an efficient turbine, and an efficient exhaust system. Continue to develop</p>	38.101	41.133	34.578	-	34.578

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
and apply advanced modeling and simulation rules and tools to initiate definition and design of efficient, very high pressure ratio core component technologies.					
<p><b>FY 2013 Base Plans:</b> Develop modeling and simulation tools for advanced components including coupled aerothermal models and turbine durability design. Conduct bench and rig test using test using surface mapping thin film temperature gages. Develop high resolution non-contact stress measurement systems for high frequency response measurement. Demonstrate engine efficiency improvements from active clearance and flow control. Conduct rig testing of high power low emission combustion. Develop improved compressor aerodynamic design tools to extend engine operability and efficiency.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop turbofan/turbojet engine components (i.e., fans, nozzles, etc.) used in engines for fighters, bombers, sustained supersonic strike and hypersonic cruise vehicles, and transports.</p> <p><b>FY 2011 Accomplishments:</b> Developed and applied advanced modeling and simulation rules and tools for advanced components. Developed durable damping/erosion coating systems. Conducted rig testing of advanced fan design for application to a variable cycle engine concept. Conducted rig testing of advanced low pressure turbine design for application to a variable cycle engine concept. Rig tested lightweight, simple, LO-compatible inlet and exhaust system.</p> <p><b>FY 2012 Plans:</b> Develop modeling and simulation rules and tools for advanced components including: advanced interactive cost analysis tools for adaptive engine components; unsteady aerodynamics and aeromechanics models; augmentor combustion processes; and probability-based cooled turbine airfoil high cycle fatigue prediction methods. Conduct bench and rig tests to validate unsteady aerodynamics/aeromechanics models and probabilistic cooled turbine airfoil high cycle fatigue prediction methods. Develop and validate test protocols and improved augmentor rig test capabilities. Continue rig testing of advanced fan design, advanced low pressure turbine design, and lightweight, simple, LO-compatible inlet and exhaust systems.</p> <p><b>FY 2013 Base Plans:</b></p>	19.237	19.510	14.672	-	14.672

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Develop modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Demonstrate methods to detect/predict incipient bearing damage to ensure engine operation. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop limited life engine components for missile and remotely piloted aircraft (RPA) applications, including long-range supersonic and hypersonic vehicles.					
<b>FY 2011 Accomplishments:</b> Developed and applied advanced modeling and simulation rules and tools for advanced limited life components. Designed and rig tested advanced limited life components.					
<b>FY 2012 Plans:</b> Develop and apply advanced modeling and simulation rules and tools for ceramic material small turbine blades, variable area turbines, and integration/performance of lubeless bearings. Develop and evaluate components to increase pressure ratio by 50% in this size class with minimum efficiency loss.					
<b>FY 2013 Base Plans:</b> Develop and apply advanced modeling and simulation tools for variable cycle component design, advanced cooling concepts, compact augmentors, and composite structures. Demonstrate advanced designs in rig testing.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.					
<b>FY 2011 Accomplishments:</b> Developed and applied advanced modeling and simulation rules and tools for advanced limited life components.					
<b>FY 2012 Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	5.309	5.400	3.993	-	3.993
	1.631	1.659	1.545	-	1.545



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Develop and apply advanced modeling and simulation rules and tools for emissions and noise to decrease detection. Develop and evaluate components to increase thrust-to-weight ratio and to decrease specific fuel consumption, production cost, and development cost.  <b>FY 2013 Base Plans:</b> Develop and apply advanced modeling and simulation tools for advanced cooling concepts, high efficiency gearboxes, and high performance airfoils. Develop advanced vibration and temperature sensors for use in demonstration of engine durability requirements.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 5.  <b>Description:</b> Develop high performance, durable components which enable adaptive turbine engine technologies.  <b>FY 2011 Accomplishments:</b> N/A  <b>FY 2012 Plans:</b> N/A  <b>FY 2013 Base Plans:</b> Conduct bench and rig tests to validate technologies and mitigate risk of adaptive fan, high pressure compressor, combustor, turbine, thermal management, and augmentor/exhaust nozzle components, which reduce specific fuel consumption, improve thrust-to-weight, and reduce cost.  <b>FY 2013 OCO Plans:</b> N/A	-	-	47.400	-	47.400
<b>Accomplishments/Planned Programs Subtotals</b>	64.278	67.702	102.188	-	102.188

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 623145: <i>Aerospace Power Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
623145: <i>Aerospace Power Technology</i>	31.346	32.639	30.061	-	30.061	27.801	28.677	28.739	28.848	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops electrical and thermal management technologies for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, affordability, and supportability of aircraft and flight line equipment. Research is conducted in energy storage and hybrid power system technologies to enable special purpose applications. Electrical power and thermal management technologies enable future military megawatt level power and thermal management needs. This project supports development of electrical power and thermal management component and systems suitable for applications to legacy and future aircraft platforms including strike and mobility concepts. Lightweight power systems suitable for other aerospace applications are also developed.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop electrical power and thermal management component and subsystem technologies with low volume displacement for delivery of high power for manned and unmanned systems.</p> <p><b>FY 2011 Accomplishments:</b> Performed hardware-in-the-loop simulation tests to validate power and thermal management systems that provide continuous thermal balancing of critical systems over a range of mission profiles. Assessed component technologies for application to directed energy weapon concepts.</p> <p><b>FY 2012 Plans:</b> Perform tip-to-tail modeling and simulation to identify solutions for platform level power and thermal management needs of next generation military air platforms.</p> <p><b>FY 2013 Base Plans:</b> Design and develop adaptive power and thermal management subsystems for next generation military air platforms based on platform level tip-to-tail modeling and simulation energy optimization.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	27.366	26.831	25.473	-	25.473
<p><b>Title:</b> Major Thrust 2.</p>	3.980	5.808	4.588	-	4.588

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Develop technologies for special purpose applications, including hybrid electrical power, thermal management systems, and energy conversion/storage components and subsystems.</p> <p><b>FY 2011 Accomplishments:</b> Developed increased fuel flexibility and integrated energy harvesting technologies for expanded special purpose applications for improved power and energy density. Performed integrated flight-weight subsystems flight tests to demonstrate power and energy density goals.</p> <p><b>FY 2012 Plans:</b> Develop fully ruggedized hybrid power subsystems and energy harvesting components. Perform flight tests of these subsystems to demonstrate achievement of power and energy density goals for special purpose applications. Explore technology set for development of power systems for micro air vehicles. Note: In FY 2012, efforts in this thrust are increased due to higher AF priorities.</p> <p><b>FY 2013 Base Plans:</b> Develop and test small and micro remote piloted aircraft power systems to provide enhanced capability and endurance and logistical fuel compatibility.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	31.346	32.639	30.061	-	30.061

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
624847: <i>Rocket Propulsion Technology</i>	56.966	60.390	55.293	-	55.293	54.888	54.689	54.727	59.374	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops rocket propulsion technologies for space access, space maneuver, missiles, the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, aging and surveillance efforts), and tactical missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, technology for sustainment of strategic systems, and innovative space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense. Technologies developed under this program enable capabilities of interest to both the Department of Defense and NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests. Aging and surveillance efforts could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.

**FY 2011 Accomplishments:**

Conducted experimental and analytical evaluation of potential hydrocarbon fuel additives to improve performance of kerosene. Continued synthesis and downselect process and scale-up of promising high energy-density materials candidates. Evaluated scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Explored and developed advanced ionic liquids. Continued scale-up experiments of promising ionic liquids for further characterization. Continued proof of concept for new computational code to predict molecular properties of various promising propellant ingredients. Continued evaluation of suitability for ionic liquid propellants for missile defense interceptor and spacecraft propulsion demonstrations. Continued technology transfer to industry for production of downselected propellants. Continued high performance bi-propellant identification and synthesis program.

**FY 2012 Plans:**

<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
3.838	4.943	6.208	-	6.208

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>Conduct experimental and analytical evaluation of potential hydrocarbon fuel additives to improve performance of kerosene. Continue synthesis and downselect process and scale-up of promising high energy-density materials candidates. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Explore and develop advanced ionic liquids including synthesis and characterization. Continue scale-up experiments of promising ionic liquids for further characterization. Continue evaluation of suitability for ionic liquid propellants for missile defense interceptor and spacecraft propulsion demonstrations. Continue technology transfer to industry for production of downselected propellants. Continue high performance bi-propellant identification and synthesis program.</p> <p><b>FY 2013 Base Plans:</b> Conduct experimental and analytical evaluation of potential hydrocarbon fuel additives to improve performance of kerosene. Continue synthesis and downselect process and scale-up of promising high energy-density materials candidates. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Explore and develop advanced ionic liquids including synthesis and characterization. Continue scale-up experiments of promising ionic liquids for further characterization. Continue evaluation of suitability for ionic liquid propellants for missile defense interceptor and spacecraft propulsion demonstrations. Continue technology transfer to industry for production of downselected propellants. Continue high performance bi-propellant identification and synthesis program.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles.</p> <p><b>FY 2011 Accomplishments:</b> Characterized, studied, and evaluated shear injector performance to ensure chamber/injector compatibility and prevent damage to engines. Validated study results in more realistic rocket-chamber conditions and begin transition of predictive tools to industry. Developed, analyzed, and transitioned advanced combustion device technology, including injectors and chambers. Developed improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Characterized design changes in high heat flux test</p>	7.988	7.364	7.766	-	7.766

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>rig in preparation for evaluating cooling channel designs. Conducted validation and verification of advanced modeling and simulation capabilities. Performed pre-selection of most promising advanced propulsion concepts; applied realistic computational models to optimize performance. Refined experimental demonstrations of proof-of-concepts; continued development of realistic computational models. Conducted system trade studies with improved performance models to evaluate potential return on investment.</p> <p><b>FY 2012 Plans:</b> Using data obtained from a hydrocarbon demonstrator engine, characterize, study, and evaluate injector performance to ensure chamber/injector compatibility and prevent damage to engines. Validate study results in more realistic rocket-chamber conditions and transition of predictive tools to industry. Feed advanced combustion device technology into hydrocarbon boost efforts, continue additional analysis on changing designs and concepts. Develop improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Evaluate novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. Conduct validation and verification of advanced modeling and simulation capabilities. Perform pre-selection of most promising advanced propulsion concepts; apply realistic computational models to optimize performance. Refine experimental demonstrations of proof-of-concepts, continue development of realistic computational models. Conduct system trade studies with improved performance models to evaluate potential return on investment.</p> <p><b>FY 2013 Base Plans:</b> Using data obtained from a hydrocarbon demonstrator engine, characterize, study, and evaluate injector performance to ensure chamber/injector compatibility and prevent damage to engines. Validate study results in more realistic rocket-chamber conditions and transition of predictive tools to industry. Begin efforts looking at multi-injector designs and control effectors. Feed advanced combustion device technology into a hydrocarbon boost demo and to various contractor designs, continue additional analysis on changing designs and concepts. Develop improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Evaluate novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. Conduct validation and verification of advanced modeling and simulation capabilities. Perform pre-selection of most promising advanced propulsion concepts; apply realistic computational models to optimize performance. Refine experimental demonstrations of proof-of-concepts, continue development of realistic computational models.</p>					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Conduct system trade studies with improved performance models to evaluate potential return on investment. Begin development of modeling tools for characterization of rocket plumes in air and space.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop advanced material applications for lightweight components and material property enhancements for current and future rocket propulsion systems.					
<b>FY 2011 Accomplishments:</b> Developed new advanced ablative components using hybrid polymers. Continued to characterize and finalize processing parameters of new nano-reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Developed new advanced materials for use with high-energy propellants. Continued to explore applications of nanocomposites for the hydrocarbon boost demo and other liquid rocket engine components and optimize processing technology using multifunctional nanomaterials. Continued to characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials exploring various transition opportunities.					
<b>FY 2012 Plans:</b> Develop new material formulations that better address the challenges inside solid rockets. Continue to characterize and finalize processing parameters of new reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Refine formulations of polymers for use in various liquid rocket engine components. Continue to characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials exploring various transition opportunities.					
<b>FY 2013 Base Plans:</b> Develop new material formulations that better address the challenges inside solid rockets. Continue to characterize and finalize processing parameters of new reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Refine formulations of polymers for use in various liquid rocket engine components. Continue to characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials exploring various transition opportunities. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	5.492	5.722	1.000	-	1.000



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 624847: <i>Rocket Propulsion Technology</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
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N/A					
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<b>Title:</b> Major Thrust 4.	24.437	17.103	11.345	-	11.345
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**Description:** Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles.

**FY 2011 Accomplishments:**  
Developed enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities. Continued development of engine health monitoring technologies supporting the hydrocarbon boost technology development effort. Developed advanced hydrocarbon engine technologies using fuels other than kerosene. Developed and demonstrated in-house, moderate scale liquid rocket component testing capability. Developed high performance compact liquid rocket engine technologies. Continued development and evaluation of bipropellant technologies.

**FY 2012 Plans:**  
Continue development of enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies. Continue development of engine health monitoring technologies supporting the hydrocarbon boost technology development effort. Develop advanced hydrocarbon engine technologies using fuels other than kerosene. Develop and demonstrate in-house, moderate scale liquid rocket component testing capability. Develop high performance compact liquid rocket engine technologies. Continue development and evaluation of bipropellant technologies. Note: In FY 2012, efforts in this thrust are decreased due to higher AF priorities.

**FY 2013 Base Plans:**  
Develop enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies. Continue development of engine health monitoring technologies supporting the hydrocarbon boost technology development effort. Develop advanced hydrocarbon engine technologies using fuels other than kerosene. Develop and demonstrate in-house, moderate scale liquid rocket component testing capability. Develop high performance compact liquid rocket engine technologies. Continue development and evaluation of bipropellant technologies. Note: In FY 2013, efforts in this thrust are decreased due to higher AF priorities.

**FY 2013 OCO Plans:**

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 5.					
<b>Description:</b> Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for satellites and satellite constellations.					
<b>FY 2011 Accomplishments:</b> Evaluated advanced plasma thrusters for microsatellites propulsion systems. Scale-up tested monopropellants, evaluated advanced ignition schemes and chamber concepts. Assessed advanced chemical propulsion technology developments for satellite thrusters; continued component developments. Developed advanced multi-mode chemical-electric propulsion concepts for satellites; continued component developments. Developed next generation high power electric spacecraft propulsion. Continued advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies.					
<b>FY 2012 Plans:</b> Characterize advanced plasma thrusters for microsatellites propulsion systems. Conduct scale-up of advanced monopropellants, evaluate advanced ignition schemes and chamber concepts. Assess advanced chemical propulsion technology developments for satellite thrusters and continue component developments. Develop advanced multi-mode chemical-electric propulsion concepts for satellites and continue component developments. Continue development of next generation high power electric spacecraft propulsion. Continue advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies.					
<b>FY 2013 Base Plans:</b> Continue characterization of advanced plasma thrusters for microsatellites propulsion systems. Conduct scale-up of advanced monopropellants, evaluate advanced ignition schemes and chamber concepts. Assess advanced chemical propulsion technology developments for satellite thrusters and continue component developments. Develop advanced multi-mode chemical-electric propulsion concepts for satellites and continue component developments. Continue development of next generation high power electric spacecraft propulsion. Continue advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies. Begin exploration into new generation of bipropellant					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	5.391	4.930	7.580	-	7.580

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
spacecraft thruster technologies. Note: In FY 2013, efforts in this thrust are increased due to higher AF priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 6.					
<b>Description:</b> Develop missile propulsion and boost technologies for space access and strike applications.					
<b>FY 2011 Accomplishments:</b> Continued the component development and risk reduction efforts for future Missile Propulsion demonstration. Demonstrated components for solid rocket motors. Developed advanced tactical propulsion technologies. Continued development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. Completed sub-scale propellant development efforts.					
<b>FY 2012 Plans:</b> Test components as part of risk reduction efforts for future missile propulsion demonstration. Develop advanced tactical propulsion technologies. Continue development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications.					
<b>FY 2013 Base Plans:</b> Develop advanced tactical propulsion technologies. Continue development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 7.					
<b>Description:</b> Develop missile propulsion technologies and aging and surveillance technologies for ballistic missiles.					
<b>FY 2011 Accomplishments:</b> Conducted advanced service life prediction technology program. Developed and applied existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	7.791	14.884	11.784	-	11.784
	2.029	5.444	9.610	-	9.610

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
and surveillance tool suite. Continued efforts to integrate advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Continued development of next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools.					
<b><i>FY 2012 Plans:</i></b> Conduct sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Integrate advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools.					
<b><i>FY 2013 Base Plans:</i></b> Conduct sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Integrate advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. Note: In FY 2013, efforts in this thrust are increased due to higher AF priorities.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	56.966	60.390	55.293	-	55.293

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	<b>PROJECT</b> 625330: <i>Aerospace Fuel Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
625330: <i>Aerospace Fuel Technology</i>	6.480	6.239	5.494	-	5.494	5.475	5.275	5.312	5.426	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation and combined cycle engines. This project also considers fuel related concepts that can increase turbine engine operational reliability, durability, mission flexibility, energy efficiency, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, sustained high-speed vehicles, and responsive space launch. Analytical and experimental areas of emphasis include evaluations of fuel properties and characteristics of alternative fuels developed from unconventional sources (such as coal, natural gas, biomass, and combinations thereof), unique/alternate fuels and components used in integrated thermal and energy management systems including high heat sink fuel capability, fuels logistics and associated vulnerabilities, and combustion diagnostics and engine emissions measurements.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Conduct evaluations and perform technical assessments of alternative hydrocarbon fuels derived from coal, natural gas, and biomass for use in legacy and advanced aerospace systems.</p> <p><b>FY 2011 Accomplishments:</b> Completed component "fit-for-purpose" evaluations of up to 100 percent synthetic paraffinic kerosene (SPK) and made recommendation as to maximum SPK in blend use. Completed initial evaluations of biomass derived aviation fuels and assessment of associated carbon dioxide footprint. Conducted follow-on component evaluations as available fuel quantities permit.</p> <p><b>FY 2012 Plans:</b> Develop link between fully-synthetic fuel composition and basic physical properties and rig test performance.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	3.087	3.151	-	-	-
<p><b>Title:</b> Major Thrust 2.</p>	1.100	1.088	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Description:</b> Develop and demonstrate advanced components and conduct performance assessments of advanced aircraft integrated thermal and energy management systems for engines and aircraft.</p> <p><b>FY 2011 Accomplishments:</b> Assessed advanced aircraft thermal management designs. Developed and assessed techniques to improve the thermal characteristics of aviation fuels used in integrated thermal and energy management systems. Developed advanced hydrocarbon based endothermic fuel technologies applicable to combined cycle engines.</p> <p><b>FY 2012 Plans:</b> Assess advanced catalyst approaches to enhancing heat sink in hydrocarbon-based endothermic fuels.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Study and evaluate low-cost approaches to reduce fuel logistics footprint to reduce cost. Study fuel logistics vulnerabilities and develop detection and mitigation technologies.</p> <p><b>FY 2011 Accomplishments:</b> Assessed aberrant logistical fuels to support field operations and investigate impact of novel corrective actions. Evaluated low-cost fuel additives and assessment of the impact on biological growth in fuel. Continued the investigation of actions to mitigate the growth of biological agents in fuel. Investigated the development of biological mutations in fuel leading to the development of resistance to chemical biocides and antifungal agents.</p> <p><b>FY 2012 Plans:</b> Develop biological growth mitigation approaches for commercial jet fuels in support of AF effort to implement commercial off-the-shelf jet fuels. Evaluate approaches for portable hydrogen generation to support emergency field power generation.</p> <p><b>FY 2013 Base Plans:</b></p>	1.000	1.000	5.494	-	5.494

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Assess impact of conversion to commercial jet fuel (without JP-8 additives) on biological growth in base fuel systems. Note: In FY 2013, efforts in this thrust are increased due to higher AF priorities. <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4. <b>Description:</b> Develop and test advanced emissions diagnostic techniques for airbreathing propulsion systems. Conduct evaluations of the combustion and emissions characteristics of aviation fuels. <b>FY 2011 Accomplishments:</b> Developed diagnostic protocols for aircraft ground emissions measurements and performed emissions evaluations on fielded engines to investigate particulate formation and composition. Developed emissions diagnostics applicable to advanced high pressure combustor systems. Assessed combustion emissions from biomass derived aviation fuels. Conducted assessment of combustion emissions from blends of coal/biomass derived aviation fuels. <b>FY 2012 Plans:</b> Implement advanced particulate diagnostics in high-pressure combustor test rig. Assess emissions from fully-synthetic fuels relative to JP-8 and JP-8/synthetic blends. <b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities. <b>FY 2013 OCO Plans:</b> N/A	1.293	1.000	-	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	6.480	6.239	5.494	-	5.494

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	158.516	134.632	127.637	-	127.637	128.591	125.661	122.320	133.944	Continuing	Continuing
622002: <i>Electronic Component Technology</i>	34.952	42.822	31.683	-	31.683	35.161	38.026	38.263	39.054	Continuing	Continuing
622003: <i>EO Sensors &amp; Countermeasures Tech</i>	21.215	28.019	23.744	-	23.744	24.415	24.996	21.534	23.692	Continuing	Continuing
624916: <i>Electromagnetic Tech</i>	18.590	-	-	-	-	-	-	-	-	Continuing	Continuing
626095: <i>Sensor Fusion Technology</i>	28.937	24.517	28.672	-	28.672	26.428	25.445	25.899	29.677	Continuing	Continuing
627622: <i>RF Sensors &amp; Countermeasures Tech</i>	54.822	39.274	43.538	-	43.538	42.587	37.194	36.624	41.521	Continuing	Continuing

**Note**

Note: In FY 2012, the efforts in Project 624916 move from Hanscom AFB, MA, to Wright Patterson AFB, OH, due to Base Realignment and Closure (BRAC) 2005 decisions. The individual efforts from Project 624916 are merged into other existing Projects in this PE.

**A. Mission Description and Budget Item Justification**

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing anytime, anywhere surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses; 3) RF antennas and associated electronics for airborne and space surveillance, together with active and passive EO sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike RF sensors and electronic combat systems. This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i>	PE 0602204F: <i>Aerospace Sensors</i>
BA 2: <i>Applied Research</i>	

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	157.497	134.787	137.101	-	137.101
Current President's Budget	158.516	134.632	127.637	-	127.637
Total Adjustments	1.019	-0.155	-9.464	-	-9.464
• Congressional General Reductions	-	-0.155			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	4.148	-			
• SBIR/STTR Transfer	-1.451	-			
• Other Adjustments	-1.678	-	-9.464	-	-9.464

**Change Summary Explanation**

FY11: Other Adjustments include -1.678 Congressional General Reductions. Technical adjustment made to Congressional Add for 2.400 to PE 0602102F Materials

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622002: <i>Electronic Component Technology</i>	34.952	42.822	31.683	-	31.683	35.161	38.026	38.263	39.054	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project focuses on generating, controlling, receiving, and processing electronic signals for RF sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare, battlespace access, and precision engagement capabilities. The technologies developed include exploratory device concepts; solid state power devices and amplifiers; low noise and signal control components; photonic components; high-temperature electronics; signal control and distribution; signal processing; multi-function monolithic integrated circuits; high-speed analog-to-digital and digital-to-analog mixed mode integrated circuits; reconfigurable electronics; power distribution; multi-chip modules; and high density packaging and interconnect technologies. This project also designs, develops, fabricates, and evaluates techniques for integrating combinations of these electronic component technologies. The project aims to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. The device and component technology developments under this project are military unique; they are based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, electronic warfare, navigation, and smart weapons.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop, analyze, demonstrate, and perform engineering trade studies for technologies for compact, affordable, multi-function subsystems for aerospace sensors.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated more compact and lightweight RF antennas using emerging materials and designs.</p> <p><b>FY 2012 Plans:</b> Complete first demonstrations of higher performance, with reduced size and weight, of advanced sensor front-ends. Develop initial trade space models for advanced sensing and electronic warfare front-ends. Continue development activity for compact and lightweight high-frequency antennas.</p> <p><b>FY 2013 Plans:</b> Complete second round of demonstrations. Using engineering trade analysis, start development of optimized sensor system technology previously demonstrated.</p>	9.887	12.450	12.238
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop and assess new microelectronic/optoelectronic material, device and fabrication technologies for next generation imaging, precision strike, and battlespace access across all Air Force domains.</p>	11.568	11.444	9.150

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622002: <i>Electronic Component Technology</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Fabricated and tested innovative electronic device concepts for wideband, reconfigurable and tunable applications. Conducted efforts to refine and further develop devices. Developed degradation models and validated key failure mechanisms for power transistors. Developed agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Started application development of high-brightness and agile waveform sources for integration into components and subsystems.</p> <p><b><i>FY 2012 Plans:</i></b> Continue to fabricate and characterize innovative electronic device concepts for wideband, reconfigurable and tunable applications. Demonstrate prototype hardware for agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Continue application development of high-brightness and agile waveform sources for integration into components and subsystems. Investigate and perform analysis for materials/device/circuit trades.</p> <p><b><i>FY 2013 Plans:</i></b> Develop optimized device concepts for multi-use cyber, sensing, warfare and communication applications. Continue to develop and demonstrate a capability to predict performance versus lifetime in military relevant environments for a large variety of emerging electronic devices. Identify key failure mechanisms for electronic device technologies and their corresponding accelerants and chemistry.</p>			
<p><b><i>Title:</i></b> Major Thrust 3.</p> <p><b><i>Description:</i></b> Develop, fabricate, and test electronic and optoelectronic devices and techniques to reduce power loss and power consumption for future imaging, electronic warfare, and ISR sensors.</p> <p><b><i>FY 2011 Accomplishments:</i></b> Refined and transitioned solutions for multi-function electronic and optoelectronic components for imaging and electronic warfare applications.</p> <p><b><i>FY 2012 Plans:</i></b> Continue to refine and transition solutions for multi-function electronic and optoelectronic components for imaging and electronic warfare applications. Investigate and analyze mixed electronic and optoelectronic functions.</p> <p><b><i>FY 2013 Plans:</i></b> N/A. Effort terminated due to higher Department of Defense priorities.</p>		6.931	7.939
<p><b><i>Title:</i></b> Major Thrust 4.</p> <p><b><i>Description:</i></b> Develop integrated design, modeling and simulation tools, and integration techniques for complex mixed-signal component development in advanced electronic component technologies.</p>		6.566	4.576

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Employed design, modeling and simulation tools, and integration techniques for complex mixed-technology (digital, RF, microwave, optical, mechanical) development in both advanced and emerging electronic component technologies. Initiated trade analysis for optimizing microsystem attributes.</p> <p><b><i>FY 2012 Plans:</i></b> Develop and demonstrate prototypes of complex mixed-technology (digital, RF, microwave, optical, and mechanical) components using both advanced and emerging electronic component technologies.</p> <p><b><i>FY 2013 Plans:</i></b> Continue demonstration of microsystem prototypes. Refine trade analysis.</p>			
<p><b><i>Title:</i></b> Major Thrust 5.</p> <p><b><i>Description:</i></b> Design and develop antennas for airborne and space-based surveillance. Develop novel and advanced antennas for lightweight, conformal arrays.</p> <p><b><i>FY 2011 Accomplishments:</i></b> FY 2011 and prior work reported under Project 4916, Major Thrust # 2; prior to BRAC.</p> <p><b><i>FY 2012 Plans:</i></b> Integrate new detection algorithm with low-cost seeker hardware. Demonstrate integration and test of new conformal digital beamforming phased array antennas on airborne radar platforms. Develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Assess the viability of obtaining novel material properties consistent with the demonstration of highly integrated subsystems based upon RF integrated circuit applications to enable small, highly directional antenna element device drivers.</p> <p><b><i>FY 2013 Plans:</i></b> Develop novel antenna concepts for wideband applications. Integrate and demonstrate lightweight conformal phased array aperture.</p>	-	5.569	5.719
<b>Accomplishments/Planned Programs Subtotals</b>	34.952	42.822	31.683

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622002: <i>Electronic Component Technology</i>

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622003: <i>EO Sensors &amp; Countermeasures Tech</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622003: <i>EO Sensors &amp; Countermeasures Tech</i>	21.215	28.019	23.744	-	23.744	24.415	24.996	21.534	23.692	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project determines the technical feasibility of advanced electro-optical aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's main goals is to improve electro-optical and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage. This project also develops the passive and active imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future aerospace surveillance and targeting. Other project goals include advanced electro-optical threat warning and countermeasures.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop innovative optical sensing technology for non-cooperative detection and identification of airborne and ground-based targets.</p> <p><b>FY 2011 Accomplishments:</b> Performed sensor concept demonstrations for long-range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Refined techniques for long-range object reconstruction based on either multi-aspect multispectral and polarimetric images or coherent laser radar data, with particular emphasis placed on synthetic and sparse aperture imaging techniques. Conducted signature collection experiments with multispectral/polarimetric imaging systems to assess military utility. Performed proof of concept experiments to assess potential utility.</p> <p><b>FY 2012 Plans:</b> Continue sensor concept demonstrations for long-range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Extend signature collection experiments and demonstrate techniques for long-range object reconstruction/ shape extraction based on multi-aspect multispectral and polarimetric images and coherent laser radar data. Initiate study of advanced sensing methods for overcoming atmospheric limitations to extended recognition range. Perform field experiments, quantify utility, and develop concepts for airborne experiments of synthetic aperture imaging in the presence of atmospheric turbulence. Develop model-based algorithms for longwave hyperspectral change detection.</p> <p><b>FY 2013 Plans:</b></p>	7.831	5.455	10.377

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Increase in FY 2013 funding is due to increased emphasis in this effort. Continue sensor concept demonstrations for long-range target identification using innovative passive and active techniques. Perform longwave hyperspectral change detection experiments to assess model-based algorithms. Continue laboratory and begin field demonstrations of agile multifunction waveforms for long-range, combined temporal synthetic aperture and remote vibrometry waveforms. Begin buildup of linear frequency modulation testbed to support long range performance quantification. Continue development of signal processing and automated signature recognition algorithms for remote vibrometry.			
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop innovative optical sensing technology to support military operations in dynamic and urban environments.</p> <p><b>FY 2011 Accomplishments:</b> Developed techniques for targeting difficult objects in dynamic urban environments. Performed sensor concept demonstrations for difficult target identification and tracking using passive and active infrared techniques. including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Refined techniques for long range object reconstruction based on either multi-aspect multispectral and polarimetric images.</p> <p><b>FY 2012 Plans:</b> Perform hyperspectral phenomenology experiments and initiate trade studies for spectral-aided tracking and relocation of targets. Continue laboratory experiments and begin field demonstrations of holographic aperture imaging for high resolution 2-D and 3-D imaging. Conduct demonstrations of multi-aperture transceivers with wavelength and transmitter location diversity. Continue development of signal processing and automated signature recognition algorithms for remote vibrometry. Continue development of 3-D imaging technologies for urban applications including scaled sensor designs, modeling and simulation and flight test of prototype sensors. Initiate development of wide area and targeting specific processing algorithms.</p> <p><b>FY 2013 Plans:</b> Develop processing methods and sensor requirements for spectral-aided tracking and relocation of targets. Conduct tower demonstrations of multi-aperture transceivers with wavelength and transmitter location diversity. Continue development of signal processing and automated signature recognition algorithms for remote vibrometry.</p>	2.582	2.809	0.672
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop optical and infrared sensors for airborne and space situational awareness and threat warning. Develop countermeasure technologies for use against infrared and electro-optical guided missile threats.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated integrated beam rider laser, direct tactical, and indirect tactical laser detection sensors supporting proactive infrared countermeasure hand-off goals. Continued assessment of advanced infrared missiles and infrared acquisition sensors.</p>	1.607	7.185	2.758

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Continued to develop proactive infrared countermeasures including the detection, discrimination, and defeat of second-generation, infrared, imaging missile seekers and sensors systems. Refined modeling and simulation capability to assess effectiveness of countermeasure techniques across mission concepts of employment.  <b>FY 2012 Plans:</b> Continue the assessment of advanced infrared missiles and infrared acquisition sensors. Continue to develop simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test countermeasure concepts. Continue development and integration of advanced laser threat detection sensors to demonstrate situational awareness and countermeasure hand-off capabilities. Continue to develop simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test threat warning and countermeasure concepts. Continue to develop performance requirements for advanced electro-optical and infrared countermeasure concepts across mission concepts of employment.  <b>FY 2013 Plans:</b> Continue the assessment of advanced infrared missiles and infrared acquisition sensors. Develop system requirements for Proactive Infrared Countermeasures (PIRCM) to defeat advance infrared (IR) guided missile and IR acquisition and tracking sensor operating in the near to mid-IR bands. Continue development and integration of advanced missile warning sensors to demonstrate situational awareness and countermeasure hand-off capabilities. Continue developing simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test threat warning and countermeasure concepts. Perform technology development of laser IRCM hardware suitable in size, weight and performance for fighter and mobility aircraft.				
<b>Title:</b> Major Thrust 4.  <b>Description:</b> Develop optical spectrum transmitter, detector and agile aperture technologies capable of sensing multiple target characteristics for robust non-cooperative target identification and future infrared countermeasure systems.  <b>FY 2011 Accomplishments:</b> Began development of beamsteering technology for long range sparse aperture and compact 3-D laser radar systems. Assessed performance characteristics of beamsteering component technologies based on liquid crystal, microwave electro-mechanical modules (MEMs), and other optical phased array concepts.  <b>FY 2012 Plans:</b> Continue development of beamsteering technology for sparse aperture and compact 3-D laser radar systems. Perform characterization of competing beamsteering component technology concepts. Initiate proof of concept experiments for an agile aperture assembly. Develop design concepts for wideband optical detector arrays suitable for coherent laser radar systems. Define and implement optimized waveforms for laser-based sensing. Continue active and passive sensor phenomenology		9.195	5.060	5.271

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622003: <i>EO Sensors &amp; Countermeasures Tech</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
experiments and model development. Demonstrate initial mid-infrared lasing and frequency conversion in waveguide and fiber media to reduce use of coupling optics for improved reliability and reduced cost of laser sources operating in harsh environments. <b>FY 2013 Plans:</b> Demonstrate high speed and random access optical phased array scanning with photon counting arrays. Demonstrate increased mid-infrared power and efficiency in waveguide and fiber media to reduce use of coupling optics for improved reliability and reduced cost of laser sources operating in harsh environments.			
<b>Title:</b> Major Thrust 5. <b>Description:</b> Develop and fabricate new semiconductor components, materials and techniques with capability to identify military and urban threats, to provide threat warning, and precisely engage targets in cluttered environments. Develop emerging optoelectronic materials, devices and circuits for next generation EO sensors exploiting advanced operational modes such as plasmonics, metamaterials, non-linear optics and quantum optics. <b>FY 2011 Accomplishments:</b> Work reported under Project 4916, Major Thrusts # 3 and 4; prior to BRAC. <b>FY 2012 Plans:</b> Capitalize on performance enhancements by integrating new materials with advanced plasmonic device technology at the macro, micro and nano scales. Applications include: non-cooperative target identification, automatic target recognition (ATR), ultraviolet to infrared threat warning, countermeasures, communications, computing and urban surveillance. <b>FY 2013 Plans:</b> Develop new semiconductor materials and devices for military-specific applications such as biological agent detection and covert communications, as well as phase-only correlation techniques for ATR.	-	7.510	4.666
<b>Accomplishments/Planned Programs Subtotals</b>	21.215	28.019	23.744

<b>C. Other Program Funding Summary (\$ in Millions)</b>												
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622003: <i>EO Sensors &amp; Countermeasures Tech</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				PE 0602204F: <i>Aerospace Sensors</i>				624916: <i>Electromagnetic Tech</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624916: <i>Electromagnetic Tech</i>	18.590	-	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2012, the efforts in Project 624916 move from Hanscom AFB, MA, to Wright Patterson AFB, OH, due to the BRAC 2005 decisions. The individual efforts from Project 624916 are merged into other existing Projects in this PE.

**A. Mission Description and Budget Item Justification**

This project develops technologies for sensor systems that cover the electromagnetic spectrum from RF to electro-optical. It develops RF antennas and associated electronics for airborne and space-based surveillance. It also investigates radio-frequency scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive electro-optical sensors for use in concert with RF sensors. It develops low-cost active sensors that use reliable high-performance solid state components for target detection and identification and missile threat warning. The project also develops passive multi-dimensional sensors to improve battlefield awareness and identify threats at long-range.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of analytical and computationally efficient tools for multi-sensor integration for target detection, tracking, and classification in a knowledge-aided framework exploiting physics-based and data dependent electromagnetic models of targets and clutter, as well as waveform diversity and dynamic sensor responses to the evolving problem solution.</p> <p><b>FY 2012 Plans:</b> Not Applicable. (Post-BRAC; this work moved to Project 627622; Major Thrust #8)</p> <p><b>FY 2013 Plans:</b> N/A</p>	3.466	-	-
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Design and develop antennas for airborne and space-based surveillance. Develop metamaterials for conformal arrays.</p> <p><b>FY 2011 Accomplishments:</b></p>	6.106	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 624916: <i>Electromagnetic Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Integrated new detection algorithm with low-cost seeker hardware. Integrated and tested new conformal digital beamforming phased array antennas on airborne radar platforms. Developed new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Assessed the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers.</p> <p><b>FY 2012 Plans:</b> Not Applicable. (Post-BRAC; this work moved to Project 622002; Major Thrust #5)</p> <p><b>FY 2013 Plans:</b> N/A</p>				
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Design and develop new electro-optical techniques and components for detecting and identifying concealed targets.</p> <p><b>FY 2011 Accomplishments:</b> Developed new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. Demonstrated new materials systems to enable conversion from pump wavelengths between 1 and 2 microns. Concluded testing of integrated focal plane arrays. Demonstrated perfect optical absorber using advanced plasmonic operational modes. Demonstrated mid-IR laser source using quasi-phase matched Gallium Arsenide material for infrared countermeasures (IRCM) applications.</p> <p><b>FY 2012 Plans:</b> Not Applicable. (Post-BRAC; this work moved to Project 622003; Major Thrust #5)</p> <p><b>FY 2013 Plans:</b> N/A</p>		5.371	-	-
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates.</p> <p><b>FY 2011 Accomplishments:</b></p>		3.647	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 624916: <i>Electromagnetic Tech</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013
Developed electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear or high explosive weapons using spectral or spectral temporal intelligence. Developed chemical biological stand off detection hardware. Completed spectral temporal sensor demonstration for cueing electro-optical and infrared persistent surveillance sensors.  <b>FY 2012 Plans:</b> Not Applicable. (Post-BRAC; this work moved to BPAC 2003; MT #5)  <b>FY 2013 Plans:</b> N/A			
<b>Accomplishments/Planned Programs Subtotals</b>	18.590	-	-

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>				<b>PROJECT</b> 626095: <i>Sensor Fusion Technology</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
626095: <i>Sensor Fusion Technology</i>	28.937	24.517	28.672	-	28.672	26.428	25.445	25.899	29.677	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops the technologies required to perform management and fusion of sensor information for timely, comprehensive situational awareness, automatic target recognition, integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes. This project also develops the technologies required to create trusted autonomic, distributed, collaborative, and self-organizing sensor systems that provide anticipatory and persistent intelligence, surveillance, and reconnaissance (ISR), situational awareness, and decision support for multi-layered sensing. This program provides the technologies for: 1) trusted sensors and trusted sensor systems that will deter reverse engineering and exploitation of our critical hardware and software technology and impede unwanted technology transfer, alteration of system capability, and prevent the development of countermeasures to U.S. systems; 2) collaborative tasking of our own distributed heterogeneous sensor networks across a region and co-opted tasking of both traditional and non-traditional adversary sensors; 3) secure sensor web backbone technologies, sensor web physical topologies, and related protocols to assure reliable trusted sensor interactions; and 4) defining architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks, developing new methodologies for system of systems sensor engineering and analysis, and new techniques for sensor network situation awareness and predictive analytics.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	6.141	1.723	10.560
<b>Description:</b> Develop automatic target recognition (ATR), sensor management, and sensor fusion technologies for target detection, tracking, and identification in ISR, and combat identification applications.			
<b>FY 2011 Accomplishments:</b> Enhanced and assessed physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Developed and evaluated automated battle space behavior analysis. Developed and assessed technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhanced multi-sensor, pixel level registration techniques as necessary to support requirements. Assessed and developed capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Conducted research of bio-inspired automatic target recognition technologies and continued to assess and evaluate these techniques for all missions with emphasis on urban applications. Assessed automatic target recognition, sensor management, and sensor fusion algorithms for urban intelligence, surveillance, and reconnaissance from small remotely piloted aircraft (RPA).			
<b>FY 2012 Plans:</b>			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Enhance and assess physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Continue development and evaluation of automated battle space behavior analysis. Continue development and assessment of technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhance multi-sensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis on urban applications. Continue assessment of automatic target recognition, sensor management, and sensor fusion algorithms for urban intelligence, surveillance, and reconnaissance from small RPA.</p> <p><b>FY 2013 Plans:</b> Increase in FY 2013 funding is due to increased emphasis in this effort. Enhance and assess physics based techniques to meet the autonomous target detection and identification requirements for intelligence, surveillance, and reconnaissance applications. Enhance multisensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy and autonomous sensor, processor, and bandwidth management. Continue research of bio-inspired automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis on urban applications. Continue assessment in Planning &amp; Direction, Collection, Processing &amp; Exploitation, Analysis &amp; Production, and Dissemination and Experimentation (PCPAD-X) integrative and virtual environments of automatic target recognition, sensor management, and sensor fusion algorithms for urban intelligence, surveillance, and reconnaissance.</p>				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop, evaluate, and demonstrate target signature models to support sensor exploitation algorithm development and testing for reconnaissance and strike mission applications.</p> <p><b>FY 2011 Accomplishments:</b> Matured target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Developed signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Developed signatures, algorithms, target modeling, and phenomenological modeling of other phenomenological features not previously exploited. Generated synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic target recognition in operationally realistic mission environments. Conducted investigation of model-driven spectral signal processing and exploitation techniques. Developed automatic target recognition algorithm-driven RF</p>		7.579	4.240	4.845

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. Initiated measurements and prediction technology to analyze space object signatures in support of space situational awareness.</p> <p><b>FY 2012 Plans:</b> Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Continue the development of signatures, algorithms, target modeling, and phenomenological modeling of other phenomenological features not previously exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in operationally realistic mission environments. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target recognition algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. Initiate measurements and prediction technology to analyze space object signatures in support of space situational awareness.</p> <p><b>FY 2013 Plans:</b> Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology for automated sensor exploitation of ground targets. Continue the development of signatures, target modeling, and phenomenological modeling of other phenomenological features not previously exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in realistic mission environments. Continue development of automatic target recognition algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data.</p>				
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop technical methods required for algorithm performance models, performance driven sensing, layered sensing and other sensing and exploitation technologies impacted by automated exploitation capabilities.</p> <p><b>FY 2011 Accomplishments:</b> Conducted investigations of sensor exploitation techniques. Developed a capability to model the performance of these technologies. Initiated validation of algorithm performance models. Developed databases and tools required to support performance modeling and assessment. Developed an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed.</p> <p><b>FY 2012 Plans:</b></p>		10.105	5.611	7.564

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Continue investigations of sensor exploitation techniques. Continue development of a capability to model the performance of these technologies. Continue validation of algorithm performance models. Continue development of databases and tools required to support performance modeling and assessment. Continue to enhance development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed.</p> <p><b>FY 2013 Plans:</b> Continue development of a capability to model the performance of sensor exploitation technologies. Continue validation of algorithm performance models to be used in the PCPAD-X integrative and virtual environments. Continue development of databases and tools required to support performance modeling and assessment. Continue to enhance development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed.</p>				
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop, evaluate, and demonstrate methodologies, techniques, and strategies to instill trust in distributed, heterogeneous sensing systems within air, space, and cyber domains.</p> <p><b>FY 2011 Accomplishments:</b> Developed new technologies and methodologies for producing adaptive, assured, and trusted architectures for multilayered sensing. Initiated development of advanced trusted sensing services, middleware, and frameworks for multilayered sensing and spectrum warfare. Initiated development of methodologies and techniques for acquisition, aggregation, and portrayal of critical data for sensing network situation awareness.</p> <p><b>FY 2012 Plans:</b> Complete development of new technologies and methodologies for producing adaptive, assured, and trusted architectures for multilayered sensing. Continue development of advanced trusted sensing services, methodologies and techniques for acquisition, aggregation, and portrayal of critical data for sensing network situation awareness. Initiate development of methods, tools, and processes to determine and assess vulnerability and mission assurance for complex system-of-systems for spectrum warfare.</p> <p><b>FY 2013 Plans:</b> Continue development of advanced trusted sensing services, middleware, and frameworks for multilayered sensing and spectrum warfare. Continue development of methods, tools, and processes to determine and assess vulnerability and mission assurance as a function of system scale in complex system-of-systems. Continue development of methods, tools, and processes to determine and assess vulnerability and mission assurance for complex system-of-systems for spectrum warfare.</p>		2.287	8.374	2.267
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Develop technologies that enable autonomic trusted features in sensor systems to deter reverse engineering and exploitation of critical military hardware and software systems.</p>		1.308	2.558	1.779

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Developed key technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Assessed and evaluated commercial technologies for application to military trusted systems. Developed autonomic trusted sensor technologies to address self-ware, self-healing, and self-organizing sensor systems. Initiated development of integrated anti-tamper and software protection solutions. Initiate development of key technology experiments to test and demonstrate trusted sensor technologies on military weapon systems.</p> <p><b><i>FY 2012 Plans:</i></b> Continue development of integrated software protection and anti-tamper systems for multilayered ISR sensing systems and spectrum warfare applications. Continue to develop key technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Continue development of autonomic trusted sensor technologies to address self-aware, self-healing, and self-organizing sensor systems. Continue to assess and evaluate commercial technologies for application to military trusted systems. Complete development of key technology experiments to demonstrate trusted sensor technologies on military weapon systems.</p> <p><b><i>FY 2013 Plans:</i></b> Continue development of integrated software protection and anti-tamper systems for multilayered ISR sensing systems and spectrum warfare applications. Continue development of autonomic trusted sensor technologies to address self-aware, self-healing, and self-organizing sensor systems. Initiate development of detect and response mechanism to remedy software and hardware supply chain vulnerabilities. Initiate development of software protection and anti-tamper solutions that integrate universal situational awareness to improve attack monitoring and prediction capabilities.</p>			
<p><b><i>Title:</i></b> Major Thrust 6.</p> <p><b><i>Description:</i></b> Develop trusted and assured avionics system network and integration technology, physical topologies, and protocols to support multi-layered sensing.</p> <p><b><i>FY 2011 Accomplishments:</i></b> Continued development of avionics system vulnerability assessment testbed. Continued development and assessment of advanced avionics bus technologies for trusted sensing. Continued analysis to exploit wired and wireless avionics sensor systems and begin analysis of technologies to protect and defend sensor systems.</p> <p><b><i>FY 2012 Plans:</i></b></p>		1.517	2.011
		1.657	

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013
Continue development of avionics system vulnerability assessment testbed. Continue development and assessment of advanced avionics bus technologies for trusted sensing. Continue analysis to exploit wired and wireless avionics sensor systems and analysis of technologies to protect and defend sensor systems.			
<b><i>FY 2013 Plans:</i></b> Continue development of avionics system vulnerability testbed. Complete development of advanced avionics bus technologies for trusted sensing. Continue analysis to exploit wired and wireless avionics sensor systems and begin analysis of technologies to protect and defend sensor systems. Initiate assessment of susceptibilities of commercial derivative avionics systems.			
<b>Accomplishments/Planned Programs Subtotals</b>	28.937	24.517	28.672

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u> Continuing	<u>Total Cost</u> Continuing
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
627622: <i>RF Sensors &amp; Countermeasures Tech</i>	54.822	39.274	43.538	-	43.538	42.587	37.194	36.624	41.521	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and assesses affordable, reliable all weather RF sensing and countermeasure concepts for aerospace applications covering the range of RF sensors including communications, navigation, ISR, and radar, both active and passive, across the air, land, sea, space and cyber domains. This project also develops and evaluates technology for ISR sensors, fire control radars, electronic warfare, integrated radar and electronic warfare systems, and offensive information operations systems. It emphasizes the detection and tracking of surface and airborne targets with RF signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple RF phenomenologies, multi-dimensional adaptive processing, advanced waveforms and knowledge-aided processing techniques. This project also develops the RF warning and countermeasure technology for advanced electronic warfare and information operations applications. Specifically, it develops techniques and technologies to detect and counter the communications links and sensors of threat air defense systems and hostile command and control networks. The project also exploits emerging technologies and components to provide increased capability for offensive and defensive RF sensors, including radar warning, RF electronic warfare, and electronic intelligence applications.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop hybrid sensor solutions to be responsive to needs and detect difficult targets. Develop jam-resistant time, position, and velocity sensors.</p> <p><b>FY 2011 Accomplishments:</b> Investigated optimal means of tightly coupling networked sensing platforms with their reference systems by leveraging onboard sensor observations as feedback to robustly calibrate the distributed, multi-platform reference. Demonstrated tightly coupled reference system technology both non-real-time and real-time.</p> <p><b>FY 2012 Plans:</b> Develop strategies to optimize reference technologies for distributed sensing missions. Explore alternatives when GPS is degraded or denied. Reduce size, weight, and power of inertial components. Enhance precision of GPS and non-GPS reference technologies.</p> <p><b>FY 2013 Plans:</b></p>	3.378	2.319	5.524

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Increase in FY 2013 funding is due to an increased emphasis in this effort. Continue to develop strategies to optimize reference technologies for distributed sensing missions. Explore alternatives when GPS is degraded or denied. Continue to reduce size, weight, and power of inertial components, while pursuing near navigation grade performance.				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Conduct applied research and development for the advancement of passive and active RF sensors; including phenomenology, modeling and simulation, algorithm development, and experimentation. Plan, execute, and maintain state-of-the-art RF sensor research and development facilities.</p> <p><b>FY 2011 Accomplishments:</b> Completed standup of Outdoor Range Radar Facility necessitated by BRAC 2005 relocation of Surveillance Facility from Rome, NY, to Wright Patterson Air Force Base, OH. Began upgrading capabilities to support state-of-the-art RF sensing experimentation. Completed installation and checkout of remote 100 foot tower housing passive sensing capability. Began development of adjunct Outdoor Range facility (Distributed Sensing Test Range, (DiSTeR)) in order to perform distributed sensing experiments. Developed an Over-The-Horizon test capability.</p> <p><b>FY 2012 Plans:</b> Complete DiSTeR. Continue upgrading Outdoor Range capabilities. Perform RF Sensing experimentation including sidelobe nulling, RF Tomography, and multispectral fusion (RF and EO/IR). Stand up X-Band multi-channel phased array radar capability. Begin establishment of Open System Architecture for Outdoor Range operations.</p> <p><b>FY 2013 Plans:</b> Continue research and development in dismount detection, sparse arrays, polarization diversity, RF tomography, MIMO for EP, and Along Track Interferometry (ATI) for GMTI. Continue Outdoor Range experimentation for concept verification and validation. Continue Outdoor Range Open System Architecture refinement and implementation. Establish new measurement capabilities at low (UHF) and high (Ku/Ka) frequency bands.</p>		26.263	16.251	11.282
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets.</p> <p><b>FY 2011 Accomplishments:</b></p>		1.165	1.025	-



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Completed systems engineering and design for reconfigurable array manifold architecture to support multiple radar configurations on a single system.</p> <p><b>FY 2012 Plans:</b> Complete development and testing of reconfigurable array manifold and initiate integration with multi-channel receiver for system demonstration. Test reconfigurable architecture against multiple configurations and missions, and utilize active array and manifold in the research of advanced RF waveforms.</p> <p><b>FY 2013 Plans:</b> N/A. Effort completed in FY 2012.</p>				
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop advanced techniques and prototype passive RF sensors to intercept, collect, locate and track enemy RF sensor systems for ISR of air and ground targets.</p> <p><b>FY 2011 Accomplishments:</b> Completed the development of a Passive Techniques Testbed for ground testing of direction finding and geolocation systems. Developed techniques to exploit passive RF phenomena to detect difficult targets.</p> <p><b>FY 2012 Plans:</b> Develop requirements for passive millimeter wave RF receivers, antennas and signal processors.</p> <p><b>FY 2013 Plans:</b> Develop signal obstacle course to verify tunable RF architecture using dynamic RF signals. This program will utilize in-house facilities, and state-of-art RF hardware deliverables from the Defense Advanced Research Projects Agency and Air Force contracts.</p>		3.838	0.197	1.518
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Develop technology to reduce size, weight, and power of RF sensors. Develop technology to enable affordable upgrades and optimally control RF and multi-intelligence sensors.</p> <p><b>FY 2011 Accomplishments:</b> Conducted research and exploration of an adaptable electronic support (ES)/electronic attack (EA) capability, including exploration of the synergy of real-time ES coupled with tailorable EA techniques.</p> <p><b>FY 2012 Plans:</b> Initiate research and modeling of distributed and layered electronic</p>		13.675	7.221	5.821

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>warfare (EW) efforts (i.e., multiple jammers or jamming techniques) for spectrum warfare. Explore and analyze a future/on-coming RF-based threat for potential counters and perform initial vulnerability assessment. Research advanced ES concepts. Continue the research and exploration of an adaptable ES/EA capability, including the exploration of the synergy of a real-time ES system coupled with tailorable EA techniques.</p> <p><b>FY 2013 Plans:</b> Continue development of distributed and layered EW effects. Continue to explore and analyze future/on-coming RF-based threats for potential counters and perform vulnerability assessments. Continue to research advanced ES concepts. Complete research and exploration of an adaptable ES/EA capability.</p>				
<p><b>Title:</b> Major Thrust 6.</p> <p><b>Description:</b> Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks.</p> <p><b>FY 2011 Accomplishments:</b> Developed an electronic chassis framework (toolkit) for applying Open Architectures (OA) to Department of Defense (DOD) sensing systems. Developed a W-band solid state power amplifier for wideband satellite communications (SATCOM) applications.</p> <p><b>FY 2012 Plans:</b> Further develop an electronic chassis framework (toolkit) for applying OA to DOD sensing systems. Further develop and demonstrate a W-band solid state power amplifier for wideband SATCOM applications.</p> <p><b>FY 2013 Plans:</b> Develop RF/EO subsystem concept prototype and begin its development to validate trade space tools. Refine trade space analysis.</p>		5.651	9.206	7.093
<p><b>Title:</b> Major Thrust 7.</p> <p><b>Description:</b> Develop sensor techniques to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications.</p> <p><b>FY 2011 Accomplishments:</b> Completed the design of a RF hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Demonstrated a constructive</p>		0.852	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. <b>FY 2012 Plans:</b> N/A. Effort eliminated in FY12 due to higher AF priorities. <b>FY 2013 Plans:</b> N/A				
<b>Title:</b> Major Thrust 8. <b>Description:</b> Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms. <b>FY 2011 Accomplishments:</b> Work reported under Project 624916, Major Thrust #1; prior to BRAC. <b>FY 2012 Plans:</b> Develop radar environment models for clutter rejection and multipath mitigation by combining electromagnetic phenomenology, cognitive algorithms and sensor signal processing pertaining to the detection and tracking of small targets in complex clutter and jamming environments for multiple-input and multiple-output (MIMO) sensor network configurations. <b>FY 2013 Plans:</b> Continue the development of models applicable to MIMO and waveform-diverse systems for multi-sensor networks operating in complex clutter and multi-path environments, and further continue the development of cognitive and phenomenology-based algorithm theory for the detection and classification of difficult targets and dismount activities for persistent and ubiquitous coverage using multi-platform configurations.		-	3.055	2.800
<b>Title:</b> Major Thrust 9. <b>Description:</b> Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency (RF) threats associated with current and future aerospace weapons systems. <b>FY 2011 Accomplishments:</b> N/A <b>FY 2012 Plans:</b> N/A <b>FY 2013 Plans:</b>		-	-	9.500

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Initiate research on distributed and layered EW effects. Explore and analyze RF-based threats for potential counters and perform vulnerability assessments. Initiate research for advanced EW concepts.			
<b>Accomplishments/Planned Programs Subtotals</b>	54.822	39.274	43.538

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	114.718	115.158	98.375	-	98.375	109.644	117.250	117.348	117.310	Continuing	Continuing
621010: <i>Space Survivability &amp; Surveillance</i>	49.356	43.211	30.199	-	30.199	33.508	38.092	35.848	34.409	Continuing	Continuing
624846: <i>Spacecraft Payload Technologies</i>	23.703	21.577	22.336	-	22.336	21.902	20.862	20.379	22.595	Continuing	Continuing
625018: <i>Spacecraft Protection Technology</i>	5.079	5.915	4.230	-	4.230	4.905	7.549	6.689	6.902	Continuing	Continuing
628809: <i>Spacecraft Vehicle Technologies</i>	36.580	44.455	41.610	-	41.610	49.329	50.747	54.432	53.404	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This Program Element focuses on four major areas. First, space survivability and surveillance develops technologies to understand space weather and the geophysics environment for mitigation and exploitation of these effects to Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by developing advanced component and subsystem capabilities. Third, spacecraft protection develops technologies for protecting U.S. space assets in potential hostile settings. The last major area, spacecraft vehicles, focuses on spacecraft platform and control technologies, and their interactions. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	111.857	115.285	114.885	-	114.885
Current President's Budget	114.718	115.158	98.375	-	98.375
Total Adjustments	2.861	-0.127	-16.510	-	-16.510
• Congressional General Reductions	-	-0.127			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	5.342	-			
• SBIR/STTR Transfer	-1.222	-			
• Other Adjustments	-1.259	-	-16.510	-	-16.510

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**Change Summary Explanation**

FY11: Other Adjustments include -1.259 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>				<b>PROJECT</b> 621010: <i>Space Survivability &amp; Surveillance</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
621010: <i>Space Survivability &amp; Surveillance</i>	49.356	43.211	30.199	-	30.199	33.508	38.092	35.848	34.409	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops technologies to understand and control the space environment for warfighter's future capabilities. The focus is on characterizing and forecasting the battlespace environment for more realistic space system design, modeling, and simulation, as well as the battlespace environment's effect on space systems' performance. This includes technologies to specify and forecast the space environment for planning operations, ensure uninterrupted system performance, optimize space-based surveillance operations, and provide capability to mitigate or exploit the space environment for both offensive and defensive operations. Finally, this project includes the seismic research program that supports national requirements for monitoring nuclear explosions.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense (DoD) operational space systems.</p> <p><b>FY 2011 Accomplishments:</b> Developed improved solar energetic particle models. Completed validation of energetic particle measurements in multiple orbital regimes. Incorporated new simulation technologies into model of spacecraft electromagnetic and plasma environment.</p> <p><b>FY 2012 Plans:</b> Complete improved database for solar flare prediction tool. Develop a new instrument to measure energetic electrons, ions, and neutral atoms in low earth orbit. Refine and expand models of the radiation belts using new data sets from recently launched spacecraft.</p> <p><b>FY 2013 Base Plans:</b> Refine the concept-of-operations for solar flare prediction unit and complete the set up of the associated solar optics laboratory. Explore properties of spacecraft materials and novel coatings to understand effects of temperature and aging on spacecraft charging and develop new techniques for charge mitigation. Continue development of space environment models and tools to support improved spacecraft design and space mission planning.</p> <p><b>FY 2013 OCO Plans:</b></p>	8.612	7.653	5.420	-	5.420

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Develop advanced target detection techniques, spectral signature libraries, and decision aids for space-based sensors and surveillance systems.					
<b>FY 2011 Accomplishments:</b> Demonstrated space-based detection of large booster missile launch through clouds. Conducted critical test of maneuver characterization sensor system with go-no-go decision point. Developed multi-phenomenology space situational awareness (SSA) sensors for space-based systems. Continued study of thermal infrared (IR) imaging spectrometer feasibility for space missions.					
<b>FY 2012 Plans:</b> Investigate space-based hypertemporal (HT) detection methods and data processing. Investigate utilization of HT detection methods for monitoring concealed activity. Continue to develop a search sensor system to monitor and characterize resident space objects and maneuver signatures. Refine concepts and applications for space-based thermal IR hyperspectral imaging payloads. Develop atmospheric compensation and temperature-emissivity separation models for space-based thermal infrared hyperspectral imaging.					
<b>FY 2013 Base Plans:</b> Evaluate space-based HT sensor performance. Complete HT data processing methodology and continue investigation of HT detection methods for concealed activity monitoring. Continue trade-space studies of components used in space-based thermal IR hyperspectral imaging payloads. Begin development of case scenarios and sensitivity analyses of atmospheric compensation and temperature-emissivity separation codes required for space-based thermal infrared hyperspectral imaging.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop techniques, forecasting tools, and sensors for ionospheric specification and forecasting, space-based geolocation demonstrations, and determination of potential radar degradation.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	14.752	10.923	5.213	-	5.213
	8.919	7.601	8.441	-	8.441



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>Delivered validated algorithm to simulate ionospheric effects on wideband radio frequency waveforms for arbitrary propagation paths to support many applications. Improved assimilation of ionospheric models and identified deficiencies in forecast models. Tested physics-based neutral density models forecasting capabilities, particularly during magnetic storms.</p> <p><b>FY 2012 Plans:</b> Investigate methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere, as well as in the solar atmosphere and solar wind. Study energy flow between solar and terrestrial environments to improve solar weather forecasts. Study plasma instabilities and plasma processes in the equatorial and solar ionospheres. Incorporate coupled physics-based models into space weather forecasts.</p> <p><b>FY 2013 Base Plans:</b> Incorporate methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere to improve solar weather forecasts. Begin modeling energy flow between solar and terrestrial environments. Study plasma instabilities and processes in the equatorial ionosphere to predict global positioning system and communication impacts.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Conduct Radiation Belt Remediation (RBR) and ionospheric research at the High-frequency Active Auroral Research Program (HAARP) site and maintain and upgrade the transmitting and diagnostic instrument infrastructure.</p> <p><b>FY 2011 Accomplishments:</b> Conducted research programs to develop controlled processes of triggered optical and infrared emissions and radio scintillation for potential DoD applications. Developed experiment using Demonstration and Science Experiment (DSX) satellite and HAARP based on studies and feedback from physical models.</p> <p><b>FY 2012 Plans:</b> Conduct applications-related demonstrations exploiting ionosphere ducts for very long-range, beyond the horizon, communications and surveillance purposes. Conduct research to characterize the interactions of radio waves and charged particles in the earth's radiation belts, using DSX satellite experiments. Develop Radiation</p>	10.822	10.890	4.933	-	4.933

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
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<p>Belt Remediation (RBR) end-to-end model and validate to improve understanding of wave particle interaction, space transmitter, and lightning phenomenology. Investigate options for future use of HAARP.</p> <p><b>FY 2013 Base Plans:</b> Conduct research to characterize the interactions of radio waves and charged particles in the earth's radiation belts, using DSX satellite experiments. Apply understanding of very low frequency (VLF) propagation from space sources and the resulting wave particle interactions. Develop a validated end-to-end model to assess the feasibility of a fielded RBR system. Implement selected options for HAARP operations.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
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<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Develop seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors.</p> <p><b>FY 2011 Accomplishments:</b> Tested and implemented refined techniques for automated processing of increasing numbers of seismic events. Tested and refined unified model results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia. Conducted detailed studies of particular challenge areas in local seismic monitoring.</p> <p><b>FY 2012 Plans:</b> Complete refinement of unified model results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia. Evaluate the results of using three-dimensional earth models in test processing of seismic events for some regions of high interest. Test potential improvements in high-frequency regional discrimination. Continue detailed studies of particular challenge areas in local seismic monitoring.</p> <p><b>FY 2013 Base Plans:</b> Migrate unified models of seismic calibration and wave propagation in Eurasia to three-dimensional physics-based models. Begin to extend coverage of unified model to all of Eurasia. Test new processing approaches to image local seismic structure.</p> <p><b>FY 2013 OCO Plans:</b></p>	6.251	6.144	6.192	-	6.192
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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	49.356	43.211	30.199	-	30.199

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 624846: <i>Spacecraft Payload Technologies</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624846: <i>Spacecraft Payload Technologies</i>	23.703	21.577	22.336	-	22.336	21.902	20.862	20.379	22.595	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; development of advanced space data generation and exploitation technologies, including infrared sensors; and development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop advanced infrared device technologies that enable hardened space detector arrays with improved detection to perform acquisition, tracking, and discrimination of space objects and missile warning.

**FY 2011 Accomplishments:**

Demonstrated tuning from 15 to 20 microns in 1 micron increments. Demonstrated field enhancement technology. Completed predictive capability for next generation of large format technology challenges. Initiated predictive capability for next generation of large format detector array and readout array technology challenges. Began space object remote characterization study.

**FY 2012 Plans:**

Expand predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Further explore space object remote characterization for adaptive, comprehensive SSA. Study effects of surface roughness on distant object polarization signature. Develop methodologies and technologies for on-orbit payload calibration and planning, emphasizing electro-optical payloads.

**FY 2013 Base Plans:**

Continue predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Explore new detector architectures/

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
5.716	6.092	6.618	-	6.618

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
methods of space object remote characterization for adaptive, comprehensive SSA. Demonstrate automated checkout and calibration technologies in a testbed environment. <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2. <b>Description:</b> Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications. <b>FY 2011 Accomplishments:</b> Further refined models for space-based spectral imaging to include additional space-based situational awareness imaging concepts and operationally responsive SSA scenarios. <b>FY 2012 Plans:</b> Continue analysis and basic experimentation in new sensing methods using radio frequency (RF) bands, polarimetry, and non-traditional interferometric techniques. <b>FY 2013 Base Plans:</b> Continue algorithm development and performance simulation to synthesize sensor input from multiple sources, onboard and off-board, to provide executable defensively based situational awareness. <b>FY 2013 OCO Plans:</b> N/A	5.366	5.382	5.771	-	5.771
<b>Title:</b> Major Thrust 3. <b>Description:</b> Develop technologies for space-based payload components such as radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging. <b>FY 2011 Accomplishments:</b> Applied the basic physical understanding of the operation of phase change materials to analog computing and device trimming applications. Transitioned radiation mitigation processes using minimally invasive techniques into libraries at major commercial foundries at the 95 nanometer (nm) and 65nm nodes. Initiated program to capitalize on high performance thermoelectric cooling devices applied to focal plane arrays. <b>FY 2012 Plans:</b>	6.726	4.861	4.614	-	4.614

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Investigate high power microwave hardening techniques for satellite systems to develop methodologies to mitigate against narrowband high power microwaves over a wide frequency range. Begin research on advanced system-on-chip integration for improved performance of space sensor systems. Complete development of radiation hardened plug-and-play interface module for reconfigurable spacecraft hardware. Initiate development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance.					
<b>FY 2013 Base Plans:</b> Continue investigation of hardening techniques to protect satellites from high power microwaves. Continue research on advanced system-on-chip integration for improved performance of space sensor systems. Continue development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Develop modeling and simulation tools for space-based ground surveillance systems, rendezvous and proximity operations, imaging of space systems, distributed satellite architecture, and space control payloads.					
<b>FY 2011 Accomplishments:</b> Began development of engineering, military utility, and cost tools that model object characterization for space superiority analysis of SSA and defensive space control technologies. Integrated data from flight experiments to refine simulations. Finished development of first-generation decision support tools for space superiority. Expanded testbed to include resource management testing capability.					
<b>FY 2012 Plans:</b> Develop engineering and military utility models for space superiority analysis of SSA and defensive operations technologies. Support more autonomous space flight experiments with cost modeling and trade studies.					
<b>FY 2013 Base Plans:</b>					
	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
	5.030	4.692	4.362	-	4.362

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Continue to refine and test spacecraft simulations that model system performance, mission planning, and experiments for future flight experiments. Develop a data center to be able to archive telemetry from flight experiments. <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 5. <b>Description:</b> Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. <b>FY 2011 Accomplishments:</b> Completed engineering model and selected technology for space experiment on enhanced communication platform. <b>FY 2012 Plans:</b> Research technologies/components that support optical communication, reconfigurable and cognitive communication, advanced RF communication, and communication security to increase the capacity and flexibility of current and future space protected communication system concepts. <b>FY 2013 Base Plans:</b> Continue development of compact, low power satellite communication systems and components with focus on flexibility and resilience for Air Force specific missions. <b>FY 2013 OCO Plans:</b> N/A	0.865	0.550	0.971	-	0.971
<b>Accomplishments/Planned Programs Subtotals</b>	23.703	21.577	22.336	-	22.336

<b>C. Other Program Funding Summary (\$ in Millions)</b>										
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 624846: <i>Spacecraft Payload Technologies</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 625018: <i>Spacecraft Protection Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
625018: <i>Spacecraft Protection Technology</i>	5.079	5.915	4.230	-	4.230	4.905	7.549	6.689	6.902	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops the technologies for protecting U.S. space assets in potentially hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1.	5.079	5.915	4.230	-	4.230
<b>Description:</b> Develop satellite threat warning technologies and tools for space defense. Exploit on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies.					
<b>FY 2011 Accomplishments:</b> Completed laboratory testing of potential defensive subsystems. Developed performance goals using engineering models. Transitioned dual usage sensor technology to multiple satellite systems.					
<b>FY 2012 Plans:</b> Develop technologies for on-orbit threat detection, assessment, and response, including development of algorithms for pursuit-evasion, space-based tasking, and co-orbital threat detection. Reduce size, weight, and power requirements for next-generation proximity detection sensors.					
<b>FY 2013 Base Plans:</b> Continue technology development of advanced on-orbit threat detection, assessment, and response, including data processing and handling for course of action determination, space-based tasking, and co-orbital threat detection. Reduce size, weight, and power for next-generation proximity detection sensors.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	5.079	5.915	4.230	-	4.230

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 625018: <i>Spacecraft Protection Technology</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 628809: <i>Spacecraft Vehicle Technologies</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
628809: <i>Spacecraft Vehicle Technologies</i>	36.580	44.455	41.610	-	41.610	49.329	50.747	54.432	53.404	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project focuses on spacecraft platforms (e.g., structures, power, and thermal management); satellite control (e.g., signal processing and control); and space experiments of maturing technologies for space qualification.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts.

**FY 2011 Accomplishments:**

Completed cryocooler component and system models with experimental data, and began to analyze cryocoolers as a single unit. Began to develop full-scale design equations for cryocoolers, increasing efficiency by 20% and decreasing manufacturing time by 200%. Demonstrated integrated, monolithic thin-film tandem solar cell. Demonstrated subcomponents of ultra high efficiency solar cell.

**FY 2012 Plans:**

Begin effort to increase cryocooler efficiency from 12% to 30% through in-house modeling, energy analysis of single and multi-stage coolers, and distributed cooling. Begin to research effective low and zero vibration cryocooler technologies, including solid state coolers. Model spacecraft thermal radiation signature phenomenology to understand the physics of IR sensing of resident space objects. Continue development of materials and concepts for 40% or greater solar cells. Demonstrate cell interconnect and module technologies to enable flexible arrays.

**FY 2013 Base Plans:**

Continue to increase cryocooler efficiency from 12% to 30% through modeling, energy analysis of single and multi-stage coolers, and cross gimbal/distributed cooling. Continue to research effective low and zero vibration cryocooler technologies, including solid state coolers. Continue to investigate approaches and concepts for

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1.	4.682	7.575	4.977	-	4.977

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
development of greater than 40% solar cells. Continue development of novel flexible array technologies to enable greater launch volume stowage efficiency.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Develop revolutionary and enabling technologies, including lighter weight, lower cost, high performance structures for space platforms; guidance, navigation, and controls hardware and software for next generation of space superiority systems.					
<b>FY 2011 Accomplishments:</b> Developed integrated thermal management subsystems for satellites. Developed nano-reinforced structures for space applications. Developed advanced guidance, navigation, and control algorithms for rapid integration and test of satellite hardware. Developed autonomous guidance, navigation, and control algorithms for proximity operations.					
<b>FY 2012 Plans:</b> Complete integrated thermal management subsystem for satellites applications. Develop novel technologies for high-efficiency deployable structures for RF frequencies and electro-optical payloads for SSA. Develop automated guidance, navigation, and control subsystem design tools for spacecraft. Investigate non-cooperative control techniques for orbital debris removal applications. Initiate development of advanced estimation-based algorithms for search, detect and track of space objects. Initiate development of next-generation electronics to enable more rapid spacecraft build and reduce spacecraft cost. Develop technologies for integrated satellite bus checkout and sensor calibration using autonomous flight architecture.					
<b>FY 2013 Base Plans:</b> Produce experimental flight hardware for thermal management of high power systems. Develop capabilities for characterizing novel, structural materials in a relevant environment. Complete efforts for automated guidance, navigation, and control subsystem design tools for spacecraft. Demonstrate and transition advanced estimation-based algorithms for search, detect, and track of space objects. Continue development of next-generation electronics to enable rapid spacecraft build and reduce spacecraft cost. Demonstrate autonomous flight architecture enabling rapid software configuration and checkout.					
<b>FY 2013 OCO Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	17.232	15.683	11.714	-	11.714

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 628809: <i>Spacecraft Vehicle Technologies</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities.</p> <p><b>FY 2011 Accomplishments:</b> Performed ground-based experiments in support of radiation belt remediation technologies. Completed DSX and payload integration and functional/environmental testing for radiation belt remediation payload. Completed development of ground support equipment and software.</p> <p><b>FY 2012 Plans:</b> Complete assembly, integration, and test of the DSX satellite to launch ready. Continue operations concept planning and development and design and build DSX mission planning tools for on-orbit operations.</p> <p><b>FY 2013 Base Plans:</b> Begin launch readiness preparations, electrical trailblazer, insertion of flight batteries and communications security equipment, and regression testing with satellite operations center in preparation for integration on the launch vehicle.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	14.666	21.197	24.919	-	24.919
<b>Accomplishments/Planned Programs Subtotals</b>	36.580	44.455	41.610	-	41.610

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Munitions</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	60.365	60.656	77.175	-	77.175	84.162	83.955	84.648	87.731	Continuing	Continuing
622068: <i>Advanced Guidance Technology</i>	19.555	20.820	32.955	-	32.955	34.081	34.227	35.884	35.565	Continuing	Continuing
622502: <i>Ordnance Technology</i>	40.810	39.836	44.220	-	44.220	50.081	49.728	48.764	52.166	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for conventional air-launched munitions. Program supports core technical competencies of fuze technology, energetic materials, damage mechanisms, munitions aerodynamics and guidance, navigation, and control, terminal seeker sciences, and munition systems effects. Technologies to be developed include blast, fragmentation, penetrating and low-collateral damage warheads, variable height/depth fuzing, precise terminal guidance, and high performance and insensitive explosives. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

**B. Program Change Summary (\$ in Millions)**

	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	61.330	60.692	64.676	-	64.676
Current President's Budget	60.365	60.656	77.175	-	77.175
Total Adjustments	-0.965	-0.036	12.499	-	12.499
• Congressional General Reductions	-	-0.036			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.550	-			
• SBIR/STTR Transfer	-0.883	-			
• Other Adjustments	-0.632	-	12.499	-	12.499

**Change Summary Explanation**

FY11: Other Adjustments include -0.632 Congressional General Reductions

FY13: Increase due to higher Air Force priorities

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622068: <i>Advanced Guidance Technology</i>	19.555	20.820	32.955	-	32.955	34.081	34.227	35.884	35.565	Continuing	Continuing

**Note**

In FY 2013, changes in funding are due to higher AF priorities.

**A. Mission Description and Budget Item Justification**

This project investigates, develops, and evaluates conventional munitions advanced guidance technologies to establish technical feasibility and military utility of advanced munition seekers, weapon aerodynamics, navigation and control, and guidance subsystem integration/simulation. Project payoffs include adverse-weather, networked, and autonomous precision munition guidance capability; increased number of kills per sortie, increased aerospace vehicle survivability, improved reliability and affordability, and improved survivability and effectiveness of conventional weapons.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Develop advanced seeker technologies for air-delivered munitions to provide high confidence target discrimination and classification, precise target location, and robust terminal tracking.

**FY 2011 Accomplishments:**

Completed model verification and demonstration of optical seeker technologies to improve targeting of obscure targets. Continued development and evaluation of test components for laser ranging, multi-mode, and synthetic aperture and high resolution radar seeker technologies for guidance in adverse weather. Continued developing theory for seeker/sensor fusion, autonomous target recognition using differential geometry and topology, and application of neurophysiology of insects to guide small vehicles to moving targets. Investigated guidance technologies that optimize delivery of selectable effects munitions through countermeasures. Began development of seeker technology for adverse weather capability for small weapons, hypersonic environments, and discriminating tunnels and surface aimpoints for boosted/high speed penetrators.

**FY 2012 Plans:**

Continue laboratory development and evaluation of test components for laser ranging, improved multi-mode, adverse weather synthetic aperture and high resolution radar modes seekers. Begin technology development of very low-cost, adverse weather capable, radar seeker for small weapons. Develop theory for seeker sensor fusion and autonomous target recognition, and study multi-weapon and conformal apertures for enhanced

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1	1.893	2.024	4.487	-	4.487



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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>resolution and beam forming on small cooperative weapons. Continue applying the neurophysiology of insects to guide small vehicles to moving targets, investigate guidance technologies that optimize delivery of selectable effects munitions through countermeasures and develop dual mode seeker for hypersonic environments and discriminating tunnels and surface aimpoints for boosted/high-speed penetrators.</p> <p><b>FY 2013 Base Plans:</b> Develop technologies that simplify, increase the flexibility, and reduce the cost of passive and active electro-optical, infrared, and radar munition seekers, with focus on combat operations in adverse weather and in high-speed engagements. Increase emphasis on seeker technologies that provide enhanced mission capability for fifth-generation aircraft, specifically as it applies to success in denied or anti-access environments. Continue developing algorithms and processing technologies to acquire and track targets with and without an operator in the loop. Continue pursuing revolutionary bio-inspired seeker technologies to increase immunity to countermeasures, to exploit multi-discriminant signatures, and to reduce the size and cost of detectors.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop advanced weapon aerodynamic, control, navigation, and networking technologies for air-delivered munitions to provide precise, agile flight, networked effects, and immunity to countermeasures.</p> <p><b>FY 2011 Accomplishments:</b> Continued developing and evaluating advanced weapon airframe and control concepts to achieve high levels of agility and maneuverability, developing multi-functional structures, and evaluating navigation systems within Global Positioning System (GPS) jamming environments. Continued development of algorithms to use wide field-of-view optical imager data, enabling navigation under GPS-denied conditions. Determined feasibility of highly compact, high throughput avionics processors and mature technologies allowing weapons to communicate and exploit information in a secure, low probability of detection mode with launch platforms, other weapons, and/or ground elements. Began developing robust control methodologies for terminal guidance and control and actuation technologies for future weapon concepts.</p> <p><b>FY 2012 Plans:</b> Continue developing advanced weapon airframe and control concepts to achieve high levels of agility and maneuverability, developing multi-functional structures, and evaluating navigation mode with other systems. Continue developing nonlinear, robust control methodologies for future weapons, such as high-speed terminal</p>	8.773	9.338	15.356	-	15.356

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>guidance on long-range strike weapons and control and actuation technologies for boosted penetrators systems within GPS jamming environments. Continue development of algorithms to use wide field-of-view optical imager data, enabling navigation under GPS-denied conditions. Develop highly compact, high throughput avionics processors, and continue maturing technologies allowing weapons to communicate and exploit information in a secure, low probability of detection.</p> <p><b>FY 2013 Base Plans:</b> Continue developing technologies that achieve precision navigation under GPS-degraded and GPS denied conditions. Identify and pursue additional weapon navigation and control networking technologies that provide enhanced mission capability in denied or anti-access environments. These technologies facilitate agile and maneuverable weapons, foster autonomy, trust, and networking, and enable precise munition control and actuation, especially for boosted penetrating munitions or during high-speed engagements.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3</p> <p><b>Description:</b> Develop guidance subsystem integration and evaluation technologies to provide open and closed loop ground testing, flight test risk reduction, and digital simulation of advanced concepts.</p> <p><b>FY 2011 Accomplishments:</b> Continued investigating precision guided munition integration technology issues and functionality in various flight environments and refining the set of interoperable simulations to evaluate emerging munitions guidance technologies. Continued evaluating multi-weapon search and attack technologies on a time critical moving target. Simulated highly innovative concepts and approaches in guidance and control technology, and develop capability to test and refine development programs and future weapon concepts in a realistic operational environment. Began development of seeker scene projection technologies and dynamic simulation technologies for terminally guided weapons.</p> <p><b>FY 2012 Plans:</b> Investigate precision guided munition integration technology issues and functionality in various flight environments and refine the set of interoperable simulations to evaluate emerging munitions technologies. Simulate highly innovative concepts and approaches in guidance and control technology. Develop capability to test and refine development programs and future weapon concepts in a realistic operational environment.</p>	8.889	9.458	13.112	-	13.112

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continue multi-weapon search and attack technologies on a time critical moving target. Begin build-up of test technologies for evaluating higher speed weapon guidance subsystem.					
<b><i>FY 2013 Base Plans:</i></b> Develop precision guided munition integration technology issues and functionality. Expand efforts to develop the capability to simulate, test, and refine innovative seeker concepts and navigation and control approaches in a realistic operational environment. Increase emphasis on guidance integration and evaluation technologies that provide enhanced mission capability for fifth-generation aircraft. Continue pursuing multiweapon search and attack technologies on a time critical moving target. Continue the build-up of test technologies for evaluating higher speed weapon guidance subsystems.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	19.555	20.820	32.955	-	32.955

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
622502: <i>Ordnance Technology</i>	40.810	39.836	44.220	-	44.220	50.081	49.728	48.764	52.166	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility for advanced explosives, fuzes, warheads, submunitions, and weapon airframes, carriage, and dispensing. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include improved storage capability and transportation safety of fully assembled weapons, improved warhead and fuze effectiveness, improved submunition dispensing, low-cost airframe/subsystem components and structures, and reduced aerospace vehicle and weapon drag.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Investigate and develop energetic materials technology that can maximize weapon lethality, while applying appropriate safety and security features.

**FY 2011 Accomplishments:**

Completed the materials properties database to develop system level models for predicting initiation. Tested and modeled explosive fills that reduce pre-detonation during high "G" loading. Developed low-density energetic materials for micro-munitions applications. Investigated high-density case materials to tailor or improve warhead performance.

**FY 2012 Plans:**

Test and model explosive fills that reduce pre-detonation during high "G" loading. Develop low-density energetic materials for micro-munitions applications. Investigate high-density case materials to tailor or improve warhead performance.

**FY 2013 Base Plans:**

Develop, model, and test explosive fills that reduce pre-detonation during high "G" loading. Continue developing low density energetic materials for small munition applications. Exploit new nanoenergetic materials to enhance and tailor explosive effects. Increase emphasis on developing energetic materials that enable increased capability and capacity for fifth-generation aircraft.

**FY 2013 OCO Plans:**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	5.743	5.586	6.267	-	6.267

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Investigate and develop fuzes for air-delivered weapon applications to develop novel energetic initiation concepts, penetration fuzing, point burst fuzes, and develop predictive models.					
<b>FY 2011 Accomplishments:</b> Continued investigating novel methods to initiate explosives, including new modeling and testing techniques. Continued to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration events. Continued to explore ground profiling imaging fuze technology. Continued development of a hardened chip fuze that uses integrated logic.					
<b>FY 2012 Plans:</b> Continue investigating novel methods to initiate explosives, including new modeling and testing techniques. Continue to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration events. Continue to explore ground profiling imaging fuze technology. Continue development of a hardened chip fuze that uses integrated logic.					
<b>FY 2013 Base Plans:</b> Expand effort to investigate novel methods to initiate explosives, including new modeling and testing techniques. Increase emphasis on fuze technologies that enable increased capacity and capability of fifth-generation aircraft, specifically as it facilitates success in denied or anti-access environments. Continue to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration events. Continue to explore ground profiling imaging fuze technology, and develop a hardened chip fuze that uses integrated logic.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Investigate and develop advanced warhead kill mechanisms, such as adaptable warheads, directional control, fragmenting warheads, and application of reactive metals.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	6.226	6.068	9.252	-	9.252
	6.958	6.787	6.824	-	6.824

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Munitions</i>	<b>PROJECT</b> 622502: <i>Ordnance Technology</i>

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>Developed compact lethality warhead technologies for use in urban terrain. Continued investigating directional warhead concepts employing reactive fragments to improve standoff kills for non-direct hit encounters. Continued developing numerical algorithms for material-to-material interface dynamics, loading, and vibration during high-speed penetration. Continued investigating techniques to control, direct, and focus the energy release from explosives in real-time by means of applying small amounts of electromagnetic energy. Investigated novel warhead designs that provide warfighting capability to deliver selectable effects on targets.</p> <p><b>FY 2012 Plans:</b> Develop compact lethality warhead technologies for use in urban terrain. Continue investigating directional warhead concepts employing reactive fragments to improve standoff kills for non-direct hit encounters. Continue developing numerical algorithms for material-to-material interface dynamics, loading, and vibration during high-speed penetration. Continue investigating techniques to control, direct, and focus the energy release from explosives in real-time by means of applying small amounts of electromagnetic energy. Investigate novel warhead designs that provide warfighting capability to deliver selectable effects on targets.</p> <p><b>FY 2013 Base Plans:</b> Continue developing novel warhead technologies, especially those that enable small, agile munitions or that provide the capability to deliver selectable effects on targets. Continue investigating directional warhead concepts to improve standoff kills for non-direct hit encounters by employing reactive fragments or by utilizing a forward focusing fragment capability. Continue developing tools to better predict material-to-material interface dynamics, loading, and vibration during high-speed penetration.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Using a system approach, investigate and develop ordnance concepts by making technology trades between fuzes, warheads, and explosives and by improving weapon carriage, release, and dispensing.</p> <p><b>FY 2011 Accomplishments:</b> Continued investigation of precision guided munition integration issues and functionality in various flight environments. Continued building and using interoperable simulations to evaluate emerging technologies.</p>	21.883	21.395	21.877	-	21.877

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Munitions</i>	<b>PROJECT</b> 622502: <i>Ordnance Technology</i>

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Continued developing and enhancing new models and improvements for micromunitions, penetrators, and counter-chemical, biological, radiological, and nuclear effects.					
<b><i>FY 2012 Plans:</i></b> Continue investigation of precision guided munition integration issues and functionality in various flight environments. Continue building and using interoperable simulations to evaluate emerging technologies. Continue developing and enhancing new models and improvements for micromunitions, penetrators, and counter-chemical, biological, radiological, and nuclear effects.					
<b><i>FY 2013 Base Plans:</i></b> Continue investigation of precision guided munition integration issues and functionality in various flight environments. Continue building and using interoperable simulations to evaluate emerging technologies. Continue developing and enhancing new models and improvements for small munitions, penetrators, and counter chemical, biological, radiological, and nuclear effects. Increase emphasis on advanced ordnance concepts that increase the capacity and capability of fifth-generation aircraft.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	40.810	39.836	44.220	-	44.220

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	110.323	141.078	106.196	-	106.196	115.779	129.588	123.288	123.359	Continuing	Continuing
624866: <i>Lasers &amp; Imaging Technology</i>	82.876	114.343	78.211	-	78.211	82.086	83.987	83.228	85.213	Continuing	Continuing
624867: <i>Advanced Weapons &amp; Survivability Technology</i>	27.447	26.735	27.985	-	27.985	33.693	45.601	40.060	38.146	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program covers research in directed energy (DE) technologies, primarily laser devices, optical beam control, and high power microwaves. In laser devices, this research includes moderate to high power laser devices that are applicable to a wide range of applications. In beam control, this research includes optical technologies to propagate lasers beams from a device and to provide ground-based optical space situational awareness. In high power microwaves, this research examines technologies for applications such as counter-electronics and non-lethal weapons. Vulnerability/lethality assessments are conducted for representative DE technologies. Research into other advanced non-conventional/innovative weapons will be conducted. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

<b>B. Program Change Summary (\$ in Millions)</b>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	103.596	111.156	117.496	-	117.496
Current President's Budget	110.323	141.078	106.196	-	106.196
Total Adjustments	6.727	29.922	-11.300	-	-11.300
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-0.078			
• Congressional Rescissions	-	-			
• Congressional Adds	-	30.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.404	-			
• SBIR/STTR Transfer	-5.852	-			
• Other Adjustments	10.175	-	-11.300	-	-11.300

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 624866: *Lasers & Imaging Technology*

Congressional Add: *Ground Optical Imaging Research and Technology.*

Congressional Add: *Space Situational Awareness.*

FY 2011	FY 2012
11.143	-
-	30.000

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>
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**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

	FY 2011	FY 2012
Congressional Add Subtotals for Project: 624866	11.143	30.000
Congressional Add Totals for all Projects	11.143	30.000

**Change Summary Explanation**

FY11: Other Adjustments include -1.025 Congressional General Reductions and 11.2 Congressional Adds

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	<b>PROJECT</b> 624866: <i>Lasers &amp; Imaging Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624866: <i>Lasers &amp; Imaging Technology</i>	82.876	114.343	78.211	-	78.211	82.086	83.987	83.228	85.213	Continuing	Continuing

**Note**

Note: In FY 2011, \$7.6 million was transferred from the \$18.8 million Congressional re-alignment of funding for ground optical imaging research and technology for ground optical imaging research and technology in this project to PE 0603444F to better carry out the intention of Congress.

**A. Mission Description and Budget Item Justification**

This project explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, and precision engagement. This project investigates the effects of laser weapons. Research in ground-based optical space situational awareness is conducted.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop high energy laser device technologies for Air Force applications.</p> <p><b>FY 2011 Accomplishments:</b> Tested laser components and subsystems incorporating advances for thermal management. Ruggedized laser sources for aircraft self-protection and improved system packaging. Demonstrated operation of a flowing diode-pumped alkaline laser. Conducted damage/vulnerability tests against real and simulated systems.</p> <p><b>FY 2012 Plans:</b> Conduct research supporting design and fabrication of weapons-class laser components, including hybrid and fiber lasers, for potential inclusion on an aircraft. Develop, design, and test selected components and subsystems for an electric laser weapon demonstrator on a large aircraft. Develop advanced electrically-powered laser concepts.</p> <p><b>FY 2013 Base Plans:</b> Conduct research supporting design and fabrication of weapons-class laser components, including hybrid and fiber lasers, for potential inclusion on an aircraft. Begin design and testing of selected components and subsystems for an electric laser weapon demonstrator on a large aircraft. Continue development of advanced electrically-powered laser concepts.</p> <p><b>FY 2013 OCO Plans:</b></p>	33.706	37.692	30.879	-	30.879

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	<b>PROJECT</b> 624866: <i>Lasers &amp; Imaging Technology</i>			
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop and demonstrate optical laser beam control technologies including atmospheric compensation and pointing and tracking. Demonstrate the integration of optical beam control technologies with laser device technologies.</p> <p><b>FY 2011 Accomplishments:</b> Upgraded horizontal propagation compensation concepts for field demonstrations. Conducted tactical relay mirror demonstrations at low power. Conducted spin-off laser communications research focused on ultra-high data rate, free-space, secure communications including atmospheric signal degradation.</p> <p><b>FY 2012 Plans:</b> Conduct laboratory testing on horizontal propagation compensation concepts and begin planning for field testing. Complete tactical relay mirror demonstrations at low and high power. Prepare to demonstrate a high power solid state laser with a beam control system on the ground.</p> <p><b>FY 2013 Base Plans:</b> Demonstrate technologies supporting force protection. Evaluate and integrate horizontal propagation compensation concepts for field testing. Demonstrate a high power solid state laser with a beam control system on the ground.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	13.095	16.919	17.418	-	17.418
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop advanced, long-range, optical technologies that support ground-based optical space situational awareness.</p> <p><b>FY 2011 Accomplishments:</b> Assessed capabilities of second-generation sodium beacon adaptive optics system on 3.5 meter telescope at visible and near-infrared wavelengths. Developed and refined technologies to advance space situational awareness.</p> <p><b>FY 2012 Plans:</b> Conduct research, including data analysis, and demonstrate compensated</p>	24.932	29.732	29.914	-	29.914

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	<b>PROJECT</b> 624866: <i>Lasers &amp; Imaging Technology</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
imaging and detection of very dim objects at visible and near-infrared wavelengths using advanced adaptive optics systems at Starfire Optical Range and Maui Space Surveillance Systems sites. Integrate and test technologies to advance ground-based optical space situational awareness.  <b>FY 2013 Base Plans:</b> Conduct research, including data analysis, and demonstrate active and compensated imaging and detection of very dim objects at visible and near-infrared wavelengths using advanced adaptive optics systems at Starfire Optical Range and Maui Space Surveillance Systems sites. Integrate and test technologies to advance ground-based optical space situational awareness. Develop initial capabilities for extending existing techniques into 24-hour operations, including covering geosynchronous orbits.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	71.733	84.343	78.211	-	78.211

	FY 2011	FY 2012
<b>Congressional Add:</b> Ground Optical Imaging Research and Technology. <b>FY 2011 Accomplishments:</b> Conducted Congressionally-directed effort. <b>FY 2012 Plans:</b> N/A	11.143	-
<b>Congressional Add:</b> Space Situational Awareness. <b>FY 2011 Accomplishments:</b> N/A <b>FY 2012 Plans:</b> Conduct Congressionally-directed effort.	-	30.000
<b>Congressional Adds Subtotals</b>	11.143	30.000

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	<b>PROJECT</b> 624866: <i>Lasers &amp; Imaging Technology</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	<b>PROJECT</b> 624867: <i>Advanced Weapons &amp; Survivability Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
624867: <i>Advanced Weapons &amp; Survivability Technology</i>	27.447	26.735	27.985	-	27.985	33.693	45.601	40.060	38.146	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project explores high power microwave (HPM) and other non-conventional/innovative weapon concepts to support applications such as non-lethal counter-personnel and disruption, degradation, and damage of electronic infrastructure. This research will allow most effects to be covert with no collateral structural or human damage. This project also investigates the effects of potential HPM weapons and mitigation of HPM effects.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Investigate technologies for HPM components. Investigate HPM and other unconventional weapon concepts using innovative technologies. Investigate advanced technologies that support force protection tactical applications, including non-lethal counter-personnel applications.</p> <p><b>FY 2011 Accomplishments:</b> Refined HPM devices and antennas to reduce size/increase effectiveness. Investigated state-of-the-art energy storage components. Investigated technologies of key Active Denial components for airborne applications. Performed full-powered, long-pulse, high duty-cycle testing of the 2.5 megawatt gyrotron source. Investigated alternative use applications for Active Denial technologies.</p> <p><b>FY 2012 Plans:</b> Investigate technologies to enhance standoff capabilities of HPM components used for electronic attack. Conduct high energy density plasma experiments.</p> <p><b>FY 2013 Base Plans:</b> Investigate technologies to provide frequency agile, broadband sources. Investigate state-of-the-art components to shrink antennas, microwave components, and energy storage/prime power technologies.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	20.019	19.922	20.375	-	20.375
<p><b>Title:</b> Major Thrust 2.</p>	7.428	6.813	7.610	-	7.610

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	<b>PROJECT</b> 624867: <i>Advanced Weapons &amp; Survivability Technology</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Assess the effects/lethality of HPM technologies. Develop and apply sophisticated models to enhance the development of HPM and related technology. Investigate technologies to counter the effects of HPM.</p> <p><b>FY 2011 Accomplishments:</b> Applied advances in target effect prediction to a suite of HPM-related codes. Demonstrated mitigation efforts applicable to Air Force and other U.S. government systems. Refined models for use in HPM system development.</p> <p><b>FY 2012 Plans:</b> Investigate mitigation effects of HPM on U.S. systems of interest including modern tactical aircraft components. Update models based on latest experimental HPM data.</p> <p><b>FY 2013 Base Plans:</b> Investigate effects of high bandwidth technologies, exploring issues to exploit/prevent cyber attack. Begin consideration of smart waveform technologies and techniques.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	27.447	26.735	27.985	-	27.985

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	114.732	127.855	104.362	-	104.362	115.129	123.632	123.104	124.234	Continuing	Continuing
625315: <i>Connectivity and Protection Tech</i>	45.950	52.543	40.834	-	40.834	50.183	55.934	56.025	54.116	Continuing	Continuing
625316: <i>Info Mgt and Computational Tech</i>	30.124	32.105	27.030	-	27.030	28.872	31.987	31.671	31.419	Continuing	Continuing
625317: <i>Information Decision Making Tech</i>	17.309	17.725	15.787	-	15.787	15.557	14.531	14.554	14.006	Continuing	Continuing
625318: <i>Operational Awareness Tech</i>	21.349	25.482	20.711	-	20.711	20.517	21.180	20.854	24.693	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops enterprise-centric information technology for the Air Force (AF). Advances in enterprise-centric information technologies are required to increase warfighter readiness and effectiveness by providing the right information, at the right time, in the right format, anytime, anywhere in the world. The Connectivity and Protection Tech project provides the technologies for multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques, as well as technologies that deter any adversary from attacking computer systems while allowing access to, presence on, manipulation of, and operational effects on adversary computer systems. This project also develops the technology base for the next generation of ultra-wide-bandwidth, multi-channelled, air- and space-based communications networks. The Information Management and Computational Tech project provides advances in information management and dissemination technologies to ensure the delivery of high-quality, timely, secure information to the warfighter, and develop technologies to produce both advanced on-demand computational processing and computer architectures with greater capacity and sophistication for addressing dynamic mission objectives under constraints imposed by AF systems. The Information Decision Making Tech project develops the technology to support the commander and staff's ability to command all viable options to achieve desired effects across the full spectrum of operations. The Operational Awareness Tech project develops technologies that improve their capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, since it develops and demonstrates the technical feasibility and military utility of evolutionary and revolutionary technologies.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>
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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	117.283	127.866	129.579	-	129.579
Current President's Budget	114.732	127.855	104.362	-	104.362
Total Adjustments	-2.551	-0.011	-25.217	-	-25.217
• Congressional General Reductions	-	-0.011			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.246	-			
• SBIR/STTR Transfer	-1.067	-			
• Other Adjustments	-2.730	-	-25.217	-	-25.217

**Change Summary Explanation**

FY11: Other Adjustments include -1.230 Congressional General Reductions and -1.500 Congressional Directed Transfers

Decrease in FY13 is due to higher Department of Defense priorities.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>				<b>PROJECT</b> 625315: <i>Connectivity and Protection Tech</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
625315: <i>Connectivity and Protection Tech</i>	45.950	52.543	40.834	-	40.834	50.183	55.934	56.025	54.116	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The AF requires technologies that enable assured, worldwide communications among all elements of the force. These communication technologies will provide en-route and deployed reachback communications for distributed collaborative military operations. This project provides the technologies for secure, self-configuring, self-healing, seamless networks; advanced communications processors; anti-jam and low probability of intercept communications techniques; agile, dynamic policy based network management capabilities; and modular, programmable, low-cost software radios. This project also develops both the technology base for the next generation of ultra-wide bandwidth, multi-channeled air- and space-based communications networks on and between platforms using the technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WDM) transceivers and prototype networks associated with advanced fiber optics and the technology to integrate current Radio Frequency (RF) with high data rate Optical Laser communications, along with network management techniques, tools, and software to support them. In addition, the AF requires technologies to deliver a full range of options in cyberspace at par with air and space dominance in each of the areas of cyber attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. This project provides the technologies required to successfully deter any adversary from attacking computer systems anytime, anywhere by ensuring the AF's ability to: 1) access, maintain presence on, and deliver effects to adversary systems; 2) detect, defend, and respond to attacks on friendly computer systems as well as provide forensic analysis concerning those attack attempts; and 3) provide cyber situational awareness to AF commanders.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	14.265	11.665	9.927
<b>Description:</b> Develop improved, survivable, higher bandwidth communications, networking, and signal processing technologies to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity.			
<b>FY 2011 Accomplishments:</b> Conducted in-house and university development of next generation advanced networking technologies for distributed military operations in an airborne environment. Completed development of low probability of intercept, and low probability of detection waveform for hand held multi-data rate radio which has a small form-factor networking and reachback capability with reduced size, weight, and power. Completed development of capability to enhance trust within airborne networks and leading wireless protocols for use in the remotely piloted aircraft environment and continue development of capability for increased V/VW band communication to a variety of airborne platforms. Initiated investigation of mission essential functions, including mini-Common Data Link (CDL), assessing threat tolerance in contested environments, and developing mitigation strategies to alleviate risk due to cyber vulnerabilities. Initiated both development of secure video distribution over tactical internets on demand and design of optimized, distributed, cross-layer protocol stacks for cognitive radio ad hoc networks with decentralized control. Initiated			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>investigation of spatial multiplex multiple-input and multiple-output (MIMO) techniques to increase channel capacity and the development of a cognitive cooperation protocol for wireless networks.</p> <p><b>FY 2012 Plans:</b> Continue in-house and university development of next generation advanced networking technologies for distributed military operations in an airborne environment. Continue both development of secure video distribution over tactical internets on demand and design of optimized, distributed, cross-layer protocol stacks for cognitive radio ad hoc networks with decentralized control. Continue investigation of spatial multiplex multiple-input and multiple-output (MIMO) techniques to increase channel capacity and the development of a cognitive cooperation protocol for wireless networks. Complete development of capability for increased V/W bandwidth communication and characterization to a variety of airborne platforms with varying data rates. Complete investigation of mission essential functions, including mini-CDL, assessing threat tolerance in contested environments, and developing mitigation strategies to alleviate risk due to cyber vulnerabilities.</p> <p><b>FY 2013 Plans:</b> Continue development of next generation advanced networking technologies for distributed military operations in an airborne environment. Continue both development of secure video distribution over tactical internets on demand and design of distributed, cross-layer protocols for cognitive radio ad hoc networks with decentralized control. Complete investigation of spatial multiplex MIMO techniques to increase channel capacity and the development of a cognitive cooperation protocol for wireless networks.</p>				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop cyber defense and supporting technologies to detect, defend, and respond to attacks on computer systems as well as provide forensic analysis concerning the attacks.</p> <p><b>FY 2011 Accomplishments:</b> Developed technology to assure operations of our networked forces (a trusted execution environment) in high threat, contested cyber environments by demonstrating a trusted cyber delivery vehicle/platform to support nearly all types of cyber operations. Developed technologies to support the ability to avoid cyber attacks by increasing redundancy, diversity, and agility in AF networks to disrupt adversary attack planning by pursuing defensive cyber maneuver and agility, polymorphic code development, and concealment and obfuscation of our networks. Completed the development of remote rendering services and thin client technology to protect end user information systems from network-delivered threats.</p> <p><b>FY 2012 Plans:</b> Continue development of technology to assure operations of our networked forces (a trusted execution environment) in high threat, contested cyber environments by demonstrating a trusted cyber delivery vehicle/platform to support nearly all types cyber operations. Complete development of technologies to support the ability to avoid cyber attacks by increasing redundancy,</p>		7.950	8.600	14.131

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
diversity, and agility in AF networks to disrupt adversary attack planning by pursuing defensive cyber maneuver and agility, polymorphic code development, and concealment and obfuscation of our networks. <b>FY 2013 Plans:</b> Continue development of technology to assure operations of our networked forces (a trusted execution environment) in high threat, contested cyber environments by demonstrating a trusted cyber delivery vehicle/platform to support nearly all types cyber operations.				
<b>Title:</b> Major Thrust 3. <b>Description:</b> Develop offensive cyber operations technologies to access, maintain presence on, and deliver effects to adversary systems. <b>FY 2011 Accomplishments:</b> Developed information system access methods and developed propagation techniques. Developed the capability to exfiltrate information from adversary information systems, developed methods for increased cyber situational awareness and understanding of the battlefield, and initiated development of methods for covert data exchange. Developed technology to deliver D5 (deny, deceive, degrade, disrupt, destroy) effects in concert with cyber platforms. Developed stealth and persistence technologies. Demonstrated the ability to identify foreign languages as a part of a cyber intelligence capability. <b>FY 2012 Plans:</b> Continue development of information system access methods and development of propagation techniques. Continue development of stealth and persistence technologies and initiate investigation into anti-reverse engineering methods. Continue development of the capability to exfiltrate information from adversary information systems, continue development of methods for increased cyber situational awareness and understanding of the battlefield, and continue the development of methods for covert data exchange. Continue development of technology to deliver D5 effects in concert with cyber platforms. Initiate development of a publish/subscribe architecture for exchange and exfiltration of information while operating within adversary information systems. <b>FY 2013 Plans:</b> Complete development of information system access methods and development of propagation techniques. Continue development of stealth and persistence technologies. Initiate investigation into anti-reverse engineering methods. Continue development of methods for increased cyber situational awareness and understanding of the battlefield, and continue the development of methods for covert data exchange. Complete development of technology to deliver D5 effects in concert with cyber platforms. Continue development of a publish/subscribe architecture for exchange and exfiltration of information while operating within adversary information systems.		9.918	19.309	9.877
<b>Title:</b> Major Thrust 4.		6.382	5.876	6.899

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>			<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b>Description:</b> Develop methods and technologies for controlled operation of information systems during attacks and fault conditions, minimizing vulnerabilities of cyber attacks, and guaranteeing the correctness of data and codes.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of assured end-to-end quality of service (QoS) and quality of information assurance (QoIA) integration to the information system during attacks and faults to provide the ability to degrade gracefully in a controlled trade space. Developed a resilient and self-regenerating information enterprise and initiate development of automatic machine regeneration of software to recover with immunity from cyber attack. Conducted challenge problem in-house and university research investigations for development of cyber domain capabilities supporting AF information systems including research in assured cyber operations in complex networks. Investigated information assurance tenants in infrastructure as a service cloud environment, concentrating on ensuring secure processing, data storage and communication in a cloud. Developed defensive techniques for wireless, mobile, and embedded systems. Initiated development of methods for disruption of malware and covert channels in data transmissions without having to detect whether malware or covert channels exist in the transmission.</p> <p><b>FY 2012 Plans:</b> Complete development of methods for disruption of malware and covert channels in data transmissions without having to detect whether malware or covert channels exist in the transmission. Initiate development of defensive cyber technologies to increase system survivability while under a cyber attack. Complete development of a resilient and self-regenerating information enterprise and continue development of automatic machine regeneration of software to recover with immunity from cyber attack. Continue challenge problem in-house and university research investigations for development of cyber domain capabilities supporting AF information systems including research in assured cyber operations in complex networks. Complete investigation of information assurance tenants in infrastructure as a service cloud environments, concentrating on ensuring secure processing, data storage and communication in a cloud. Complete development of defensive techniques for wireless, mobile, and embedded systems with vulnerability analysis and threat identification for emerging commercial wireless standards.</p> <p><b>FY 2013 Plans:</b> Continue development of defensive cyber technologies to increase system survivability while under a cyber attack. Continue challenge problem in-house and university research investigations for development of cyber domain capabilities supporting AF information systems including research in assured cyber operations in complex networks. Continue investigation into secure processing by using hardware techniques and logic reconfiguration to drastically reduce major vulnerabilities.</p>					
<b>Title:</b> Major Thrust 5.			7.435	7.093	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b>Description:</b> Develop and assess wideband network technologies for application in the air and space environment, including existing and emerging modulation schemes and protocols and consisting of high capacity RF and optical technologies, for next generation platform communications.</p> <p><b>FY 2011 Accomplishments:</b> Completed in-flight verification of the Dense Wavelength Division Optical Multiplexing single mode system by testing data integrity, switching times and latency, total throughput, reconfigurability, bit error rates, and wavelength to wavelength switching during flight operations, and complete development of 40 channel multi-wavelength optical network for on-board air and space applications. Conducted ground tests of RF waveform generation to demonstrate high capacity persistent sensor data transmission, and complete the fabrication, integration and flight tests of flight test ready optical data link system.</p> <p><b>FY 2012 Plans:</b> Initiate development of an all-optical communications system for airborne and satellite platforms, that can distribute very high rate digital data and RF signals in high shock, vibration, and radiation environments. Initiate development of next generation of high capacity data links supporting transmission requirements of airborne and spaceborne sensors. Continue ground tests of RF waveform generation to demonstrate high capacity persistent sensor data transmission.</p> <p><b>FY 2013 Plans:</b> N/A. Effort terminated due to higher Department of Defense priorities.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>	45.950	52.543	40.834

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>				<b>PROJECT</b> 625316: <i>Info Mgt and Computational Tech</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
625316: <i>Info Mgt and Computational Tech</i>	30.124	32.105	27.030	-	27.030	28.872	31.987	31.671	31.419	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The AF requires the capability to maximize the value, sharing, management, and use of its information and information assets in achieving its mission objectives as the importance of information grows in the current net centric environment. Technology development in this project must be capable of taking advantage of future net-centric environments including new structured and ad hoc processes in response to rapidly changing warfare challenges. Advances in robust information management focus on quality of service and flow of information within the enterprise, information transformation and brokering, secure information sharing across and among domains, and collaboration of workflow within the enterprise. Technologies addressed in this project include the ability to globally share, discover, and access information across organizational, functional, and coalition boundaries and between and among domains, the timely delivery of information to tactical assets, the tailoring and prioritization of information based on mission needs and importance, and the scaling, robustness, and collaboration features required of the AF net-centric information management environment. In addition, the AF requires the development of superior, intelligent, on-demand computing to enable information superiority. Technology development in this project focuses on producing: 1) computer architectures with greater capacity and sophistication for addressing constrained, dynamic mission objectives; 2) "game-changing" computing power to the warfighter; 3) disruptive computing technology power at the edge and the power behind grid services; and 4) interactive and real-time computing improving the usability of high performance computing to the AF. It includes technologies in computational sciences and engineering, computer architectures, and software intensive systems.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	12.322	6.357	6.476
<b>Description:</b> Investigate and develop technologies for decision quality information dissemination services via publish, subscribe, and query with coalition partners as part of the Global Information Grid (GIG).			
<b>FY 2011 Accomplishments:</b> Initiated development of tools and safeguards required to quickly and reliably transfer information from a higher classification domain to a lower classification domain, as well as to coalition partners. Completed development of secure cross-domain information brokering for the discovery and sharing of web services. Researched service oriented architecture (SOA) based architectures and services for tactical and enterprise environments that are secure, survivable, and resilient to cyber attack and failures. Completed research into dynamic information management system infrastructure.			
<b>FY 2012 Plans:</b>			



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Continue development of tools and safeguards required to quickly and reliably transfer information from a higher classification domain to a lower classification domain, as well as to coalition partners. Complete research of SOA based architectures and services for tactical and enterprise environments that are secure, survivable, and resilient to cyber attack and failures.</p> <p><b>FY 2013 Plans:</b> Continue development of tools and safeguards required to quickly and reliably transfer information from a higher classification security-domain to a lower classification security-domain, as well as to coalition partners. Initiate research into mission responsive data systems by mapping mission requirements to information flows.</p>				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop processing technologies for real-time global information systems.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of algorithms and simulations of select computationally challenging and relevant problems in the scalable quantum information science testbed for optimized information searching and processing. Researched petaflops embedded processing on-demand and multi-core computing by completing the design and the fabrication of a prototype for increased control of power. Developed next generation advanced computing techniques, enabling superior information processing for AF warfighters through in-house and university research. Developed advanced processing capabilities to enable the collection and processing of information as close to the sensor as feasible. Completed nano-computer technology development to provide high performance, secure, scalable, and survivable information dissemination. Initiated a study of quantum cores as the foundational building blocks for a multi-core quantum processor. Initiated study of reconfigurable electronics to enable intelligent AF systems to perform autonomous operations.</p> <p><b>FY 2012 Plans:</b> Continue development of next generation advanced computing techniques, enabling superior information processing for AF warfighters through in-house and university research. Complete study of reconfigurable electronics to enable intelligent AF systems to perform autonomous operations. Continue development of tools to analyze codes and dynamic execution profiles and extract threads suitable for multi-core computation. Complete development of advanced processing capabilities to enable the collection and processing of information as close to the sensor as feasible. Continue development of embedded processing for on-demand and multi-core petaflops computing. Continue study of quantum cores as the foundational building blocks for a multi-core quantum processor.</p> <p><b>FY 2013 Plans:</b> Continue development of next generation advanced computing techniques, enabling superior information processing for AF warfighters through in-house and university research. Complete development of tools to analyze codes and dynamic execution</p>		11.250	14.462	11.155

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
profiles and extract threads suitable for multi-core computation. Continue development of petaflops embedded processing on-demand and multi-core computing by demonstrating increased control of power of fabricated prototype. Complete study of quantum cores as the foundational building blocks for a multi-core quantum processor.				
<b>Title:</b> Major Thrust 3.		1.975	4.485	4.543
<b>Description:</b> Develop secure cross domain discovery services for access to services outside of existing domain. Develop the tools to allow collaboration of workflows required by the AF net-centric information management environment.				
<b>FY 2011 Accomplishments:</b> Completed implementation of multi-level lightweight directory access protocol (LDAP) prototype solution into a fully SOA compliant architecture, leveraging the existing multi-level repository (MLR) technology. Developed a flexible fusion container to allow upstream processing without affecting core critical infrastructure and demonstrated its application to tracking of evasive non-linear targets. Initiated development of advanced technologies to effectively manage large data storage warehouses within agile enterprise environments by developing quality of service enabled information management services coupled to network routing and management for tactical edge internet protocol (IP)-based networks. Completed research efforts to improve the timeliness and accuracy of the human review process using advanced information technology. Developed novel information management techniques as applied to all domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG. Developed information management capabilities in support of force protection.				
<b>FY 2012 Plans:</b> Initiate development of an automated security annotation framework that provides safeguarding mechanisms for the AF enterprise. Complete an open architecture for the efficient integration of sensors, algorithms, and computing and communications hardware to support real-time tactical information collection, exploitation, and command and control. Complete development of advanced technologies to effectively manage large data storage warehouses within agile enterprise environments by developing quality of service enabled information management services coupled to network routing and management for tactical edge IP-based networks. Continue development of novel information management techniques as applied to all domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG. Continue to develop information management capabilities in support of force protection.				
<b>FY 2013 Plans:</b> Continue development of an automated security annotation framework that provides safeguarding mechanisms for the AF enterprise. Continue development of novel information management techniques as applied to all security-domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG.				
<b>Title:</b> Major Thrust 4.		4.577	6.801	4.856

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b>Description:</b> Develop the architectural mechanisms that form the basis for predictable software and high assurance systems.</p> <p><b>FY 2011 Accomplishments:</b> Designed and demonstrated the functionality of a modular trusted computing base architecture. Developed a trusted, automated cyber defense capability to reduce response time down to milli-seconds vice hours. Developed the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Completed architectures for cognitive systems and demonstrated hierarchical brassboard. Initiated development of a co-design of a multi-core Tagged Secure Processor, a Zero-Kernel Operating System, and Application Development Environment inherently resistant to malicious software and inherently compliant with multiple-independent-levels-of-security (MILS) systems. Initiated design of a hybrid complementary metal-oxide semiconductor (CMOS)/memristor logic unit that is compact and efficient for encryption algorithm implementation.</p> <p><b>FY 2012 Plans:</b> Initiate developing architectures for a compact large array of many node clusters with very low power demand for intelligent systems. Complete development of trusted, automated cyber defense capability to reduce response time down to milli-seconds vice hours. Continue development of a co-design of a multi-core Tagged Secure Processor, a Zero-Kernel Operating System, and Application Development Environment inherently resistant to malicious software and inherently compliant with MILS systems. Continue design of a hybrid CMOS/memristor logic unit that is compact and efficient for encryption algorithm implementation. Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems including correct concurrent code for trusted embedded multi-core systems.</p> <p><b>FY 2013 Plans:</b> Complete development of a trusted, automated cyber defense capability to reduce response time down to milliseconds vice hours. Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Complete development of a co-design of a multi-core Tagged Secure Processor, a Zero-Kernel Operating System, and Application Development Environment inherently resistant to malicious software and inherently compliant with MILS systems. Complete design of a hybrid CMOS/memristor logic unit that is compact and efficient for encryption algorithm implementation.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>	30.124	32.105	27.030

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

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**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>	<b>PROJECT</b> 625317: <i>Information Decision Making Tech</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
625317: <i>Information Decision Making Tech</i>	17.309	17.725	15.787	-	15.787	15.557	14.531	14.554	14.006	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The AF requires advances in technologies enabling the effective execution of military objectives that will vastly improve the ability to support the commander and staff's ability to command all viable options to achieve desired effects across the full spectrum of operations (air, space, and cyberspace) at all levels of war (strategic, operational, and tactical) and during all phases of conflict. Technology development in this project addressing this requirement include anticipatory decision support and course of action development, planning, scheduling and assessment, and the real-time effective portrayal of complex data sets.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop next generation monitoring, planning, and assessment technologies enabling aerospace commanders to develop effects-based campaigns.</p> <p><b>FY 2011 Accomplishments:</b> Initiated the development of capability for a full-spectrum analysis for effects attainment at all levels of a campaign, linking leading indicators to desired and undesired effects. Developed and began demonstrating capabilities, including wargaming technologies, to mix kinetic and non-kinetic options, continuously forecast the direct, indirect, and cascading effects of each course of action (COA), and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options. Initiated the development and demonstration of decision workflow and workload management capabilities to manage the command and control constellation of resources focused on specific missions. Completed investigation of methods to seamlessly move between geospatial and non-geospatial data to enhance situational awareness and enable integrated decisions over the air, space, and cyberspace domains.</p> <p><b>FY 2012 Plans:</b> Initiate development of a hybrid wargaming concept of decision theory and game theory to provide safeguarded courses of action in adversarial environments with varying degrees of partial information. Complete development and demonstrate capabilities to mix kinetic and non-kinetic options, continuously forecast the direct, indirect, and cascading effects of each COA, and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options. Continue investigation of full-spectrum, quantitative analysis techniques that aid operational assessor's ability to link actions to effects to desired objectives. Continue the development and demonstration of decision workflow and workload management capabilities to analyze and prioritize courses of action for space control missions and space situational awareness.</p> <p><b>FY 2013 Plans:</b></p>	10.933	7.856	8.108

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>	<b>PROJECT</b> 625317: <i>Information Decision Making Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Continue development of decision theory and initiate the development of a capability for autonomous adaptive re-planning in a real-time simulation environment using a case-based planning system. Continue investigation of full-spectrum, quantitative analysis techniques that aid operational assessor's ability to link actions to effects to desired objectives. Initiate development of robust autonomous control algorithms for heterogeneous and distributed assets capable of learning in dynamic environments.</p> <p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Investigate, analyze, and develop technologies for planning, execution, and automatic rapid reconfiguration of distributed intelligent and integrated command and control (C2) information systems to achieve the commander's intent throughout varying crisis levels.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of advanced interactive displays, including information visualizations, suitable for both high fidelity, accurate wargames and for rapid deployment in harsh environments with C2 applications and command centers. Initiated development of capabilities to be more agile within a net centric enabled environment by developing models of cyber network attacks to enable better operation of cyber assets with air and space assets. Conducted in-house and university development of next generation planning, decision making, and COA tools supporting the commander's ability to exercise a wide range of command and execution options for AF forces. Completed research to achieve the capability to analyze multiple COA having cascading effects in near-real-time. Completed the investigation of processes and technologies and recommend solutions to enable the Air Operations Center (AOC) to conduct kinetic/non-kinetic monitor-assess-plan-execute (MAPE) procedures while under degraded conditions due to cyber attacks. Developed the capability to rapidly integrate and analyze C2 systems within a developmental environment. Initiated development of a cooperative multi-agent system to maximize sensor task completions and provide an adaptive and flexible solution to deal with the dynamics of new asset task allocations.</p> <p><b>FY 2012 Plans:</b> Continue development of capabilities to be more agile within a net centric enabled environment by developing models of cyber network attacks to enable better operation of cyber assets with air and space assets. Complete development of a cooperative multi-agent system to maximize sensor task completions and provide an adaptive and flexible solution to deal with the dynamics of new asset task allocations. Continue in-house and university development of next generation planning, decision making, and COA tools supporting the commander's ability to exercise a wide range of command and execution options for AF forces.</p> <p><b>FY 2013 Plans:</b> Complete development of capabilities to be more agile within a net centric enabled environment by developing models of cyber network attacks to enable better operation of cyber assets with air and space assets. Continue in-house and university development of next generation planning, decision making, and COA tools supporting the commander's ability to exercise a wide range of command and execution options for AF forces. Continue development of techniques for visualizing cyber situational</p>		6.376	9.869	7.679

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>	<b>PROJECT</b> 625317: <i>Information Decision Making Tech</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
awareness, appropriately selecting cyber assets to achieve desired effects and assuring Ops Center functionality while under cyber attack.			
<b>Accomplishments/Planned Programs Subtotals</b>	17.309	17.725	15.787

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>				<b>PROJECT</b> 625318: <i>Operational Awareness Tech</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
625318: <i>Operational Awareness Tech</i>	21.349	25.482	20.711	-	20.711	20.517	21.180	20.854	24.693	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The AF requires technologies that improve and automate their capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This project provides not only a network-centric, collaborative intelligence analysis capability that enables the fusion of multi-intelligence and sensor sources to provide timely situational awareness, understanding, and anticipation of the threats in the battlespace, but also the advanced, novel exploitation technologies needed to intercept, collect, locate, and process both covert and overt raw data from intelligence and sensor sources. It leads the research, discovery, and development of technology that enables the fusion of multi-intelligence sources to provide accurate object tracking and identification (ID), situational awareness, understanding, and anticipation of the threats in the battlespace (air, ground, space, and cyber). It also leads in the development of advanced exploitation technologies to maximize the intelligence gained from our adversaries in the areas of spectral detection and geolocation, signal recognition and analysis, and the data tagging, tracking, and tracing via the insertion of secure, imperceptible signal embedding for future fusion and understanding of the information.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	7.138	14.226	10.188
<b>Description:</b> Develop higher-level fusion and the enabling text information/knowledge base technologies to achieve situational awareness and understanding at all command levels for dynamic planning, assessment, and execution processes.			
<b>FY 2011 Accomplishments:</b> Completed demonstration of the ability to track targets, exploiting feature data, for an average of greater than one hour in moderate traffic density. Began development and implementation of techniques to increase the scalability of tracking algorithms from 10's to 1000's of ground targets in a large rural-urban environment. Initiated development of techniques and algorithms to improve analysis of multi-sensor data for mining data across multi-INT repositories for behavioral patterns to identify terrorist networks and track movement and that process moving-target indication data from airborne sensors, and automatically classify airborne targets, including remotely piloted aircraft (RPA). Developed techniques for analyzing and assessing activities to support situation assessment. Conducted in-house and university research dealing with level 1 - 4 fusion using multi-source intelligence and sensor feeds to advance the AF capability to anticipate the variety of threats from the ground, air, and cyber domains. Initiated development of automated generation of ontology from free-text or heterogeneous data sources and develop augmented analyst workflow techniques. Designed an automated feature aided tracking and pattern recognition capability for onboard processing of a high-resolution, wide-area video staring sensor with cueing from lower bandwidth sensors.			
<b>FY 2012 Plans:</b>			



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>	<b>PROJECT</b> 625318: <i>Operational Awareness Tech</i>

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<p>Continue development and implementation of techniques to increase the scalability of tracking algorithms from 10's to 1000's of ground targets in a large rural-urban environment. Initiate development of techniques for performing indications and warnings, pattern recognition, and information fusion for information exploitation. Continue development of techniques and algorithms to improve analysis of multi-sensor data for mining data across multi-INT repositories for behavioral patterns to identify terrorist networks and track movement and that process moving-target indication data from airborne sensors, and automatically classify airborne targets, including RPA. Complete design and demonstration of an automated feature aided tracking and pattern recognition capability for onboard processing of high-resolution, wide-area video staring sensor with cueing from lower bandwidth sensors. Continue in-house and university research dealing with level 1 - 4 fusion using multi-source intelligence and sensor feeds to advance the AF capability to anticipate the variety of threats from the ground, air, and cyber domains. Complete development of techniques for analyzing and assessing activities to support situation assessment. Initiate developing software to aid the analyst in determining the entity's behavior, including direction, speed, maneuvers, and operation of equipment. Complete development of automated generation of ontology from free-text or heterogeneous data sources, and automated task suggestion in response to requests for intelligence information and assessments.</p> <p><b>FY 2013 Plans:</b> Complete development and implementation of techniques to increase the scalability of tracking algorithms from 10's to 1000's of ground targets in a large rural-urban environment. Continue development of techniques for performing indications and warnings, pattern recognition, and information fusion for information exploitation. Complete development of techniques and algorithms to improve analysis of multi-sensor data for mining data across multi-INT repositories for behavioral patterns to identify terrorist networks and track movement and that process moving-target indication data from airborne sensors, and automatically classify airborne targets, including RPA. Continue in-house and university research dealing with level 1 - 4 fusion using multi-source intelligence and sensor feeds to advance the AF capability to anticipate the variety of threats from the ground, air, and cyber domains. Continue developing software to aid the analyst in determining the entity's behavior, including direction, speed, maneuvers, and operation of equipment.</p>			
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop digital information exploitation technologies for electronic communications and special signals intelligence, imagery, and measurement signatures to increase accuracy, correlation, and timeliness of the information.</p> <p><b>FY 2011 Accomplishments:</b> Developed and evaluated watermarking techniques for multimedia, beginning extensions to non-multimedia data and executable code. Completed supervisory control and data acquisition (SCADA) protocols, integrated all algorithms, demonstrated and tested a prototype analysis suite as an extensible proof-of-concept, and verified and validated algorithm performance against simulated real-world data. Conducted in-house and university research in advanced exploitation techniques that maximize the AF ability to gather, process, and display information from multi-INT sources identifying threats to warfighters across the physical and cyber</p>	10.874	8.249	9.574

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>	<b>PROJECT</b> 625318: <i>Operational Awareness Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>domains. Developed optimizing exploitation across sensors to enhance multi-intelligence fusion and initiated investigation into a deeper understanding of and linguistic decomposition of tonal languages. Developed a capability to detect and geo-locate surveillance and mobile threat emitters and initiated investigation to perform specific emitter identification to exploit differences in transient characteristics and aid in intercept disambiguations. Initiated development of a signal processing methodology for exploiting multi-sensor data to detect, identify, and geo-locate emerging signals. Initiated development of a target-specific baseline to test and integrate a capability to assess and exploit passive, semi-active and active radio frequency identification devices and biologically motivated techniques for object detection, recognition, and tracking in video and imagery data.</p> <p><b>FY 2012 Plans:</b> Complete the development and evaluation of watermarking techniques, focused on streaming media. Complete investigation of combined temporal, spatial, and frequency techniques to provide a multi-domain approach for information provenance, pedigree, and assurance. Continue the development, test, and evaluation of real-time, tactical information exploitation software using laboratory tools and operational data. Develop a wide variety of exploitation methods to enhance signals situational awareness. Continue in-house and university research in advanced exploitation techniques that maximize the AF ability to gather, process, and display information from multi-INT sources identifying threats to warfighters across the physical and cyber domains. Complete the development of optimizing exploitation across sensors to enhance multi-INT fusion.</p> <p><b>FY 2013 Plans:</b> Complete the development, test, and evaluation of real-time, tactical information exploitation software using laboratory tools and operational data. Continue development of a wide variety of exploitation methods to enhance signals situational awareness. Continue in-house and university research in advanced exploitation techniques that maximize the AF ability to gather, process, and display information from multi-INT sources identifying threats to warfighters across the physical and cyber domains.</p>				
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of the "core" nation state model (to include both the physical and social subsystems). Completed development to model and explore policy actions and reactions taken by the different modeled entities activities. Initiated development of tools for the analyst to identify the optimum set of leverage points to meet commander's objectives. Initiated the identification of degree to which the adversary can achieve hypothesized enemy COAs (eCOAs) based on predicted goals. Completed verification and validation for integration of the various frameworks. Initiated development of an integrated set of</p>		3.337	3.007	0.949

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>	<b>PROJECT</b> 625318: <i>Operational Awareness Tech</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
possible combinations of adversary COAs and adversarial intentions based on the adversary's abilities and capabilities to perform activities associated with various domains.			
<b><i>FY 2012 Plans:</i></b> Continue development of tools for the analyst to identify the optimum set of leverage points to meet commander's objectives. Continue the identification of degree to which the adversary can achieve hypothesized eCOAs based on predicted goals. Continue development of an integrated set of possible combinations of adversary COAs and adversarial intentions based on the adversary's abilities and capabilities to perform activities associated with various domains.			
<b><i>FY 2013 Plans:</i></b> Complete development of tools for the analyst to identify the optimum set of leverage points to meet commander's objectives. Complete the identification of degree to which the adversary can achieve hypothesized eCOAs based on predicted goals. Complete development of an integrated set of possible combinations of adversary COAs and adversarial intentions based on the adversary's abilities and capabilities to perform activities associated with various domains.			
<b>Accomplishments/Planned Programs Subtotals</b>	21.349	25.482	20.711

<b>C. Other Program Funding Summary (\$ in Millions)</b>												
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>							
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				PE 0602890F: <i>High Energy Laser Research</i>							
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
Total Program Element	51.514	53.791	38.557	-	38.557	40.177	41.296	42.045	42.514	Continuing	Continuing
625096: <i>High Energy Laser Research</i>	51.514	53.791	38.557	-	38.557	40.177	41.296	42.045	42.514	Continuing	Continuing

**Note**

Note: In FY 2013, reductions due to higher Department of Defense priorities.

**A. Mission Description and Budget Item Justification**

This program funds Department of Defense (DoD) high energy laser (HEL) applied research through the HEL Joint Technology Office (JTO). HEL weapon systems have many potential advantages including speed-of-light delivery, precision target engagement, significant magazine depth, low-cost per kill, and reduced logistics requirements. HELs have the potential to perform a wide variety of military missions including defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles and the ultra-precision negation of targets in urban environments with minimal collateral damage. This program is part of an overall DoD HEL Science and Technology program. Efforts funded under this program are generally chosen for their potential to have an impact on multiple HEL systems and multiple Service missions while complimenting Service/Agency programs that are directed at specific Service needs. A broad range of technologies are addressed in key areas such as electrically powered lasers, laser beam control, and laser lethality mechanisms. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

**B. Program Change Summary (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	53.384	54.059	52.297	-	52.297
Current President's Budget	51.514	53.791	38.557	-	38.557
Total Adjustments	-1.870	-0.268	-13.740	-	-13.740
• Congressional General Reductions	-	-0.268			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.433	-			
• Other Adjustments	-0.437	-	-13.740	-	-13.740

**Change Summary Explanation**

FY11: Other Adjustments include -0.437 Congressional General Reductions

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>
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Decrease in FY13 is due to higher Department of Defense priorities.

**C. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Advance solid-state laser development.</p> <p><b>FY 2011 Accomplishments:</b> Conducted a joint-high power electric laser product improvement program under the Robust Electric Laser Initiative (RELI). Concurrent design verification experiments supported risk-reduction efforts.</p> <p><b>FY 2012 Plans:</b> Continue a joint high power electric laser product improvement program as part of the RELI effort. Monitor and evaluate progress toward a 25 kilowatt (kW) laser design.</p> <p><b>FY 2013 Base Plans:</b> Conduct a joint high power electric laser product improvement program as part of the RELI effort. Prepare for government-sponsored measurements to validate RELI performance.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	12.206	12.696	11.850	-	11.850
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Mature technologies that will provide system level performance commensurate with fieldable solid-state laser devices.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated building blocks for highly efficient, compact, modular laser system with weapons-class applications. Scaled eye-safer laser technologies to kW-class power levels. Conducted Service and Agency proposal call for FY 2011 and awarded seven new efforts.</p> <p><b>FY 2012 Plans:</b> Develop high reliability/cost efficient diode pump sources. Scale eye-safer laser technologies to militarily relevant higher powers. Develop high power delivery fiber technologies. Conduct an industry proposal call for FY 2012.</p> <p><b>FY 2013 Base Plans:</b></p>	9.534	9.781	4.950	-	4.950

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Develop highly efficient, compact, modular electric laser systems. Conduct a Service and Agency proposal call for FY 2013. <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3. <b>Description:</b> Conduct system-level technology development to facilitate scaling of free electron lasers (FELs) to weapons-class power levels. <b>FY 2011 Accomplishments:</b> Demonstrated technologies that can support a megawatt (MW) class future FEL system. Conducted a Service and Agency proposal call for FY 2011, and awarded three new efforts. <b>FY 2012 Plans:</b> Demonstrate technologies that can support a MW class future FEL system. Conduct an industry proposal call for FY 2012. <b>FY 2013 Base Plans:</b> Reduction is due to higher Department of Defense priorities. <b>FY 2013 OCO Plans:</b> N/A	4.304	4.299	-	-	-
<b>Title:</b> Major Thrust 4. <b>Description:</b> Investigate new technologies that have revolutionary potential for HEL applications. <b>FY 2011 Accomplishments:</b> Explored novel laser technologies to improve efficiency and decrease mass/volume. Evaluated new materials for HEL application. Initiated a military study on short pulse laser technology applications. Scaled electrically pumped alkali lasers to moderate power levels. Conducted a Service and Agency proposal call for FY 2011 and awarded eight new efforts. <b>FY 2012 Plans:</b>	8.637	9.652	8.970	-	8.970

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Explore novel laser technologies to improve efficiency and decrease mass/volume. Evaluate new materials for HEL applications. Prepare to demonstrate applications for short pulse laser technology. Continue to scale electrically pumped alkali lasers to kW-class power levels. Conduct an industry proposal call for FY 2012.</p> <p><b>FY 2013 Base Plans:</b> Explore novel laser technologies to improve efficiency and decrease mass/volume. Evaluate new materials for HEL applications. Demonstrate applications for short pulse laser technology. Continue to scale electrically pumped alkali lasers to increased power levels. Conduct a Service and Agency proposal call for FY 2013.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Develop technology to support high performance beam control systems and integrated demonstrations.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated advanced component and control techniques for difficult environments, such as high-speed flight, high turbulence, and extended ranges. Conducted a Service and Agency proposal call for FY 2011 and awarded eight contracts.</p> <p><b>FY 2012 Plans:</b> Implement beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles, and shipboard systems) in stressing environments. Conduct an industry proposal call for FY 2012.</p> <p><b>FY 2013 Base Plans:</b> Implement beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles, and shipboard systems) in stressing environments. Conduct a Service and Agency proposal call for FY 2013.</p>	9.630	9.841	5.080	-	5.080
<p><b>Title:</b> Major Thrust 6.</p> <p><b>Description:</b> Conduct laser vulnerability experiments on materials, components, and targets. Develop a lethality database, and integrate into a systems-level architecture plan and lethality models.</p> <p><b>FY 2011 Accomplishments:</b></p>	4.385	4.557	4.587	-	4.587



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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Integrated lethality data into campaign-level HEL system models. Continued laser vulnerability experiments on materials, components, and targets. Updated laser systems inputs for the Joint Munitions Effect Manual. Developed a counter-Unmanned Aircraft System (UAS) vulnerability assessment.</p> <p><b>FY 2012 Plans:</b> In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Conduct laser vulnerability experiments on materials, components, and targets. Update laser systems inputs for the Joint Munitions Effect Manual.</p> <p><b>FY 2013 Base Plans:</b> In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Conduct laser vulnerability experiments on materials, components, and targets. Update laser systems inputs for the Joint Munitions Effect Manual.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 7.</p> <p><b>Description:</b> Maintain and evaluate high-fidelity engineering models for HEL system scenario evaluation and incorporation into the HEL toolkit. Provide for HEL system modeling for mission-level war gaming activities.</p> <p><b>FY 2011 Accomplishments:</b> Provided maintenance, verification, validation, and accreditation for updated system level HEL models. Conducted mission-level HEL engagement scenarios and wargame HEL concepts. Incorporated predictive avoidance modeling into existing HEL toolkit.</p> <p><b>FY 2012 Plans:</b> Provide maintenance, verification, validation, and accreditation for updated system level HEL models. Conduct mission-level HEL engagement scenarios and wargame HEL concepts. Incorporate predictive avoidance modeling into existing HEL toolkit.</p> <p><b>FY 2013 Base Plans:</b> Provide maintenance, verification, validation, and accreditation for updated system level HEL models. Conduct mission-level HEL engagement scenarios and wargame HEL concepts. Incorporate predictive avoidance modeling into existing HEL toolkit.</p> <p><b>FY 2013 OCO Plans:</b></p>	2.818	2.965	3.120	-	3.120

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	51.514	53.791	38.557	-	38.557

<b>D. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**E. Acquisition Strategy**  
N/A

**F. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	39.638	60.719	47.890	-	47.890	29.672	29.169	31.373	36.992	Continuing	Continuing
632100: <i>Laser Hardened Materials</i>	18.426	23.007	11.564	-	11.564	13.050	15.971	15.894	16.655	Continuing	Continuing
633153: <i>Non-Destructive Inspection Development</i>	2.208	5.142	8.413	-	8.413	6.766	4.831	4.870	4.962	Continuing	Continuing
633946: <i>Materials Transition</i>	16.794	30.214	27.020	-	27.020	9.856	8.367	10.609	15.375	Continuing	Continuing
634918: <i>Deployed Air Base Demonstrations</i>	2.210	2.356	0.893	-	0.893	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops and demonstrates materials technology for transition into Air Force systems. The program has five projects which develop: (1) hardened materials technologies for the protection of aircrews and sensors; (2) non-destructive inspection and evaluation technologies; (3) transition data on structural and non-structural materials for aerospace applications; (4) airbase operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities; and (5) advanced materials for space applications. Efforts in the program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	33.414	39.738	41.699	-	41.699
Current President's Budget	39.638	60.719	47.890	-	47.890
Total Adjustments	6.224	20.981	6.191	-	6.191
• Congressional General Reductions	-	-0.019			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	21.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.570	-			
• Other Adjustments	6.794	-	6.191	-	6.191

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 633946: *Materials Transition*

Congressional Add: *Metals Affordability Initiative*

FY 2011	FY 2012
8.000	-

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>
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**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

Congressional Add: *Silicon Carbide Composites Research*

Congressional Add: *Advanced Materials Research*

Congressional Add Subtotals for Project: 633946

Congressional Add Totals for all Projects

	FY 2011	FY 2012
-	-	12.500
-	-	8.500
8.000	8.000	21.000
8.000	8.000	21.000

**Change Summary Explanation**

FY11: Other Adjustments include -0.206 General Congressional Reductions, 8.000 Congressional Adds, and -1.000 Congressional Directed Transfers

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 632100: <i>Laser Hardened Materials</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
632100: <i>Laser Hardened Materials</i>	18.426	23.007	11.564	-	11.564	13.050	15.971	15.894	16.655	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in threat environments. Advanced materials technologies are also developed and demonstrated to enhance protection for Air Force sensor systems to ensure safety, survivability, and operability in threat environments.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Develop and demonstrate materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems.

**FY 2011 Accomplishments:**

Evaluated hardening performance of current materials and technologies to threats. Demonstrated detector hardening for next generation United States Air Force targeting platforms. Developed new persistent surveillance detectors with increased survivability. Designed more robust Visible/Near Infrared (Vis/NIR) detectors. Incorporated materials in optical test bed configuration and test performance in relevant environments. Demonstrated optimized nonlinear optical limiter materials for damage protection. Demonstrated semiconductor optical limiter materials performance for damage protection. Verified performance of hardening Short Wavelength Infrared (SWIR) sensor systems. Evaluate materials survivability for relevant environments. Developed advanced thin film concepts for enhanced fixed filter performance.

**FY 2012 Plans:**

Continue to evaluate and prioritize advanced rugate coatings and liquid crystal materials technologies as protection against laser and directed energy threats aimed at sensors and avionics. Transition most mature coatings and liquid crystal hardening technologies for next generation targeting platforms. Initiate demonstrations of promising and viable coating and liquid crystal technologies into next generation of persistent surveillance sensor designs as well as demonstrating strategies to mitigate directed energy damage for Vis/NIR detectors and SWIR detectors that are critical for Intelligence, Surveillance, and Reconnaissance (ISR) sensors. Continue testing of damage limiting semiconductor materials in test bed configuration to determine viability for protection of tactical and strategic space sensors and for SWIR systems. Assess vulnerability of current seekers/munitions against emerging countermeasure threats. Develop and demonstrate personnel protection technologies,

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	15.585	18.920	5.996	-	5.996

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>		<b>PROJECT</b> 632100: <i>Laser Hardened Materials</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
including tailored rugate coatings and liquid crystal materials technologies specific for visor applications, against visible and SWIR directed energy laser threats.					
<b>FY 2013 Base Plans:</b> Continue demonstrations of viable coating and liquid crystal technologies for future persistent surveillance sensor designs as well as continue demonstrating strategies to mitigate directed energy damage for Vis/NIR detectors, SWIR and Mid Wave Infrared (MWIR) detectors critical to ISR sensors. Demonstrate damage-limiting semiconductor materials in a test bed configuration representing protection of strategic SWIR space sensors. Employ computation materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings and dyes for use in sensor hardening. Decrease in FY13 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Develop and demonstrate materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrew to perform required missions in a threat environment.					
<b>FY 2011 Accomplishments:</b> Investigated susceptibility of candidate detectors for Head Mounted Display (HMD) systems. Demonstrated enhanced photorefractive hybrid materials concepts for Air Force passive protection applications. Identified personnel protection technologies for the visible and SWIR. Evaluated performance of optical coatings within visor applications.					
<b>FY 2012 Plans:</b> Develop and demonstrate personnel protection technologies for the visible and SWIR. Continue to evaluate performance and initiate process development of optical coatings within visor applications.					
<b>FY 2013 Base Plans:</b> Continue development and demonstration of personnel protection technologies for the visible/NIR and SWIR. Fabricate and demonstrate performance of agile and fixed optical coatings and dyes for use in visor applications. Characterize eye protection technologies using computational materials science tools.					
<b>FY 2013 OCO Plans:</b>					
	2.841	4.087	5.568	-	5.568

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 632100: <i>Laser Hardened Materials</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	18.426	23.007	11.564	-	11.564

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
Not Applicable.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 633153: <i>Non-Destructive Inspection Development</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633153: <i>Non-Destructive Inspection Development</i>	2.208	5.142	8.413	-	8.413	6.766	4.831	4.870	4.962	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced nondestructive inspection/evaluation (NDI/E) technologies to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. NDI/E capabilities greatly influence and/or limit many design, manufacturing, and maintenance practices. This project provides technology to satisfy Air Force requirements to extend the lifetime of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels. Equally important is assuring manufacturing quality, integrity, and safety requirements.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop and demonstrate advanced technologies to improve capabilities to inspect for cracks and other damage to extend the total safe life of turbine engines.</p> <p><b>FY 2011 Accomplishments:</b> Transitioned NDI/E approaches to extend the life of fracture-critical gas turbine engine components.</p> <p><b>FY 2012 Plans:</b> Investigate NDI/E approaches to measure material properties to extend the life and increase durability of fracture-critical gas turbine engine components.</p> <p><b>FY 2013 Base Plans:</b> Develop NDI/E approaches to nondestructively measure material properties, detect and characterize materials and damage state for the purpose of extending the life and increasing durability of fracture critical gas turbine engine components</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>	0.635	1.377	1.772	-	1.772
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability.</p> <p><b>FY 2011 Accomplishments:</b></p>	0.343	0.421	0.541	-	0.541



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 633153: <i>Non-Destructive Inspection Development</i>			
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Developed inspection methods and sensor technology for signature and material integrity of next generation LO material systems.					
<b>FY 2012 Plans:</b> Advance inspection methods and sensor technology for signature and material integrity of next generation LO material systems.					
<b>FY 2013 Base Plans:</b> Develop and demonstrate inspection methods and sensor technology for signature and material integrity of existing and next generation LO material systems. Develop, demonstrate, and validate inspection methods to identify damage and register positions that enable/ensure signature assessment.					
<b>FY 2013 OCO Plans:</b> N/A.					
<b>Title:</b> Major Thrust 3					
<b>Description:</b> Develop and demonstrate advanced systems status monitoring technologies to provide on-board and embedded sensing to gain continuous awareness of the state of key subsystems.					
<b>FY 2011 Accomplishments:</b> Demonstrated optimal sensing approaches for real-time health monitoring of high-temperature protection and advanced material systems and characterize power scavenging and signal transmission issues. Transitioned smart sensor technologies for wiring health analysis. Transitioned field and depot-level inspection tools for assessing the structural health of airframes.					
<b>FY 2012 Plans:</b> Continue to transition smart sensor technologies for wiring health analysis. Continue to transition field and depot-level inspection tools for assessing the structural health of airframes.					
<b>FY 2013 Base Plans:</b> Continue to develop and transition augmented field and depot-level inspection technologies for assessing the structural integrity of airframes. Integrate computational materials science tools with life prediction methods to increase accuracy of life prediction. Demonstrate and transition advanced turbine engine process/status monitoring technologies to enable adaptive functions. Increase in FY13 due to higher Air Force priority in turbine engines.					
<b>FY 2013 OCO Plans:</b>					
	1.230	3.344	6.100	-	6.100

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 633153: <i>Non-Destructive Inspection Development</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	2.208	5.142	8.413	-	8.413

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
Not Applicable.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force									<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>				<b>PROJECT</b> 633946: <i>Materials Transition</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
633946: <i>Materials Transition</i>	16.794	30.214	27.020	-	27.020	9.856	8.367	10.609	15.375	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced materials and processing technologies for fielded and planned Air Force weapon, airframe, and propulsion applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. This design and scale-up data improves the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Develop and demonstrate Materials and Processes (M&P) technologies for air vehicle and subsystems to enhance lift, propulsion, LO performance, power generation management, and affordability of air vehicles.

**FY 2011 Accomplishments:**

Developed and transitioned production-level capable processes for producing large area, high-quality diamond windows for airborne high power microwave directed energy weapons. Demonstrated and compared advantages of approaches for high energy density capacitors for pulsed power applications. Initiated validation of processing methods and lifing tools for hybrid disk concepts. Initiated validation of processing methods and lifing methodologies for advanced (Silicon Carbide) SiC/SiC-based composites. Developed and demonstrated methodology for process control and validation of next generation LO material systems.

**FY 2012 Plans:**

Demonstrate high rate production-capable processes for producing large area, high quality diamond windows for airborne high power microwave directed energy weapons. Develop materials enabling critical components for next-generation airborne high energy lasers that are solid state, electrically-powered, and significantly higher efficiency. Advance validation of processing methods and lifing tools for graded microstructure turbine engine disk concepts. Advance validation of processing methods and lifing methodologies for advanced high temperature SiC/SiC-based composites. Develop and validate next generation NDE/I sensor systems for advanced LO material systems.

**FY 2013 Base Plans:**

<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
4.139	4.168	6.320	-	6.320

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 633946: <i>Materials Transition</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Transition high rate production-capable processes for producing large area, high quality diamond windows for airborne high power microwave directed energy weapons. Continue development of materials enabling critical components for next generation airborne high energy lasers that are solid state, electrically-powered, with significantly higher efficiency. Transition validation of processing methods and lifing tools for graded microstructure turbine engine disk concepts, high temperature SiC/SiC-based composites, and validate next generation NDE/I sensor systems for advanced LO material systems. Demonstrate 2700 SiC/SiC composites for advanced high temperature components.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop and demonstrate M&amp;P technologies to enhance the sustainability of aerospace systems by lowering Operations and Maintenance (O&amp;M) costs to ensure the full operability and safety of systems and personnel.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated and transitioned innovative technologies for bare base utilities.</p> <p><b>FY 2012 Plans:</b> Demonstrate and transition innovative technologies for bare base utilities.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY13 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>	0.692	0.750	-	-	-
<p><b>Title:</b> Major Thrust 3</p> <p><b>Description:</b> Develop and demonstrate affordable, novel high temperature materials/structures and thermal management concepts to enable future defense capabilities for prompt global strike concepts.</p> <p><b>FY 2011 Accomplishments:</b></p>	3.963	4.296	1.000	-	1.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>		<b>PROJECT</b> 633946: <i>Materials Transition</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>						
Explored fabrication techniques for hot structure and thermal protection systems from advanced ceramics, ceramic matrix composites, hybrids, advanced metals, and intermetallics.						
<b>FY 2012 Plans:</b> Advance multi-material structure to optimally address operational temperature zones for hot structure and thermal protection systems from advanced ceramics, ceramic matrix composites, hybrids, advanced metals, and intermetallics.						
<b>FY 2013 Base Plans:</b> Continue to advance multimaterial structure to optimally address operational temperature zones for hot structure and thermal protection systems made out of advanced ceramics, ceramic matrix composites, hybrids, advanced metals, and intermetallics. Decrease in FY13 due to higher Department of Defense priorities.						
<b>FY 2013 OCO Plans:</b> N/A.						
<b>Title:</b> Major Thrust 4						
<b>Description:</b> Develop and demonstrate M&P technologies to increase power and efficiency for adaptive turbine engine propulsion and subsystem integration.						
<b>FY 2011 Accomplishments:</b> N/A.						
<b>FY 2012 Plans:</b> N/A.						
<b>FY 2013 Base Plans:</b> Transition production processes and materials to enable an adaptive turbine engine prototype. Perform critical evaluations of technology in the operating environment. Increase in FY13 due to higher Air Force priority in turbine engines.						
<b>FY 2013 OCO Plans:</b> N/A.						
<b>Accomplishments/Planned Programs Subtotals</b>						
		8.794	9.214	27.020	-	27.020

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 633946: <i>Materials Transition</i>
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	FY 2011	FY 2012
<b>Congressional Add:</b> Metals Affordability Initiative <i>FY 2011 Accomplishments:</i> Conducted Congressionally-directed effort. <i>FY 2012 Plans:</i> N/A.	8.000	-
<b>Congressional Add:</b> Silicon Carbide Composites Research <i>FY 2011 Accomplishments:</i> N/A. <i>FY 2012 Plans:</i> Conducted Congressionally-directed effort.	-	12.500
<b>Congressional Add:</b> Advanced Materials Research <i>FY 2011 Accomplishments:</i> N/A. <i>FY 2012 Plans:</i> Conducted Congressionally-directed effort.	-	8.500
<b>Congressional Adds Subtotals</b>	8.000	21.000

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>				<b>PROJECT</b> 634918: <i>Deployed Air Base Demonstrations</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
634918: <i>Deployed Air Base Demonstrations</i>	2.210	2.356	0.893	-	0.893	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced, rapidly deployable airbase technologies that enable agile combat support by reducing airbase manpower requirements, reducing airbase setup times and improving the protection and survivability of deployed Air Force Expeditionary (AFE) warfighters. Affordable, efficient technologies are developed and demonstrated to provide deployable infrastructure, weapon system support, blast and munition force protection and firefighting capability for deployed AEF operations.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Demonstrate and transition deployable infrastructure airbase technologies, to reduce airlift and manpower requirements, setup time, and sustainment costs in support of AEF operations.</p> <p><b>FY 2011 Accomplishments:</b> Continued to demonstrate and transition integrated, advanced power generation and distribution methods. Demonstrated methods and technologies to evaluate operating surfaces for ability to sustain remote and autonomous aircraft operations. Demonstrated and optimize rapid temporary and permanent high temperature operating surface repairs.</p> <p><b>FY 2012 Plans:</b> Characterize, demonstrate, and fabricate airbase alternative energy generation, power grid conditioning, and distribution methods. Characterize and develop best practices for aircraft operating surface evaluation and repair technologies. Characterize, fabricate, and demonstrate aircraft operating surface high operating temperature materials and technologies.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY13 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>	1.049	1.098	-	-	-
<p><b>Title:</b> Major Thrust 2</p>	1.161	1.258	0.893	-	0.893

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: <i>Advanced Materials for Weapon Systems</i>	<b>PROJECT</b> 634918: <i>Deployed Air Base Demonstrations</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Demonstrate and transition technologies to provide force protection and fire fighting capability for deployed AEF operations.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated and transitioned agile, lightweight adaptive blast suppression materials in representative structures. Demonstrated and optimized candidate fire fighter safety technologies against representative environments and threats. Demonstrated and transitioned candidate ultrahigh pressure nozzles, and other technologies in fire safety systems. Developed and demonstrated reactive and responsive materials for platforms, expeditionary structures, and personnel protection.</p> <p><b>FY 2012 Plans:</b> Characterize and maintain competency for fabrication and demonstration of technologies for airbase structural protection against blast and fragmentation. Characterize and develop technologies for airbase fire fighting and composite materials combustion.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY13 due to higher Department of Defense priorities. Remaining funds will provide for orderly transition and shutdown of facilities no longer needed in this research area.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	2.210	2.356	0.893	-	0.893

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
Not Applicable.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603199F: <i>Sustainment Science and Technology (S&amp;T)</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	2.764	5.780	6.565	-	6.565	9.839	9.371	9.454	9.620	Continuing	Continuing
635351: <i>Technology Sustainment</i>	2.764	5.780	6.565	-	6.565	9.839	9.371	9.454	9.620	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates sustainment technologies such as materials, corrosion, and structures for transition into Air Force systems to increase readiness and reduce life cycle costs. Technologies matured and demonstrated in this program impact affordability and availability of fielded and future aerospace weapon systems by extending service life, ensuring flight safety, reducing sustainment costs, and ensuring mission readiness and capability. This project develops and demonstrates technologies that can be implemented to address operational sustainment issues on existing systems as well as supports new sustainability through demonstration of technologies related to robust life cycle management, system design, fleet management decision making, and mission capability. Studies are conducted to identify and analyze design methodologies that focus on building in sustainability into future applications. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for sustaining existing and future aerospace systems that have military utility and address warfighter needs.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	2.935	5.780	6.744	-	6.744
Current President's Budget	2.764	5.780	6.565	-	6.565
Total Adjustments	-0.171	-	-0.179	-	-0.179
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.077	-			
• SBIR/STTR Transfer	-0.079	-			
• Other Adjustments	-0.015	-	-0.179	-	-0.179

**Change Summary Explanation**

FY11: Other Adjustments include -0.015 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603199F: <i>Sustainment Science and Technology (S&amp;T)</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop, demonstrate, and transition system health management technologies. Conduct studies and analyses to design in sustainability into future applications.</p> <p><b>FY 2011 Accomplishments:</b> Continued efforts related to fatigue/corrosion diagnostics sensors and algorithms. Refined efforts to verify and validate real-time material state awareness capability for engine and airframe structural components. Incorporated health assessment technologies into system data environment.</p> <p><b>FY 2012 Plans:</b> Verify capability of state-of-the-art reasoners to assess component health and real-time awareness for engine components. Develop and demonstrate real time diagnostic technologies. Develop life prediction model capability to support risk-based decision making and prognostics. Incorporate health assessment technologies into system data environment.</p> <p><b>FY 2013 Base Plans:</b> Refine verification of capability of state-of-the-art reasoners to assess component health and real-time awareness for engine components. Complete development of real-time diagnostic technologies. Continue to develop life prediction model capability to support risk-based decision making and prognostics. Complete incorporating health assessment technologies into system data environment.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	1.309	2.842	3.304	-	3.304
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop, demonstrate, and transition technologies to improve component design, maintenance, replacement, and concepts for performance improvement and reduced maintenance burden.</p> <p><b>FY 2011 Accomplishments:</b> Integrated structural life enhancement/replacement application concepts. Demonstrated risk-based approach to structural integrity decision making. Demonstrated capability of certification by analysis to reduce design time, implementation, and sustainment costs.</p> <p><b>FY 2012 Plans:</b></p>	0.480	0.940	1.146	-	1.146

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603199F: <i>Sustainment Science and Technology (S&amp;T)</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Continue to evaluate concepts for integrated structural life enhancement/replacement concepts. Demonstrate risk-based approach to structural integrity decision making. Assess capability of certification by analysis to reduce design time, implementation, and sustainment costs.</p> <p><b>FY 2013 Base Plans:</b> Continue efforts to evaluate concepts for integrated structural life enhancement/replacement concepts. Begin efforts to demonstrate risk-based approach to structural integrity decision making. Refine assessment of capability of certification by analysis to reduce design time, implementation, and sustainment costs.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop, demonstrate, and transition technologies to improve existing and new components to decrease downtime, costs, and increase reliability.</p> <p><b>FY 2011 Accomplishments:</b> Evaluated technological means to adjust maintenance management and operational sustainment. Demonstrated high reliability maintenance free repair technologies. Demonstrated improved maintenance and repair data base systems.</p> <p><b>FY 2012 Plans:</b> Evaluate technological means to adjust system management and operational sustainment. Demonstrate high reliability repair technologies. Demonstrate improved maintenance and repair data base systems.</p> <p><b>FY 2013 Base Plans:</b> Continue to evaluate technological means to adjust system management and operational sustainment. Demonstrate high reliability repair technologies. Demonstrate improved maintenance and repair data base systems.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	0.975	1.998	2.115	-	2.115
<b>Accomplishments/Planned Programs Subtotals</b>	2.764	5.780	6.565	-	6.565

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603199F: <i>Sustainment Science and Technology (S&amp;T)</i>
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**D. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**E. Acquisition Strategy**

Not Applicable.

**F. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	42.105	121.666	37.657	-	37.657	31.366	29.808	33.499	34.675	Continuing	Continuing
63665A: <i>Advanced Aerospace Sensors Technology</i>	22.113	96.044	16.269	-	16.269	15.015	12.809	15.773	15.209	Continuing	Continuing
6369DF: <i>Target Attack and Recognition Technology</i>	19.992	25.622	21.388	-	21.388	16.351	16.999	17.726	19.466	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

Divided into two broad project areas, this program develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project develops and demonstrates advanced technologies for electro-optical sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The second project develops and demonstrates radio frequency and electro-optical sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

<b>B. Program Change Summary (\$ in Millions)</b>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	44.677	53.075	52.615	-	52.615
Current President's Budget	42.105	121.666	37.657	-	37.657
Total Adjustments	-2.572	68.591	-14.958	-	-14.958
• Congressional General Reductions	-	-0.009			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	10.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.340	-			
• SBIR/STTR Transfer	-0.981	-			
• Other Adjustments	-0.251	58.600	-14.958	-	-14.958

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 63665A: *Advanced Aerospace Sensors Technology*

Congressional Add: *Program Increase*

Congressional Add: *Blue Devil 1*

FY 2011	FY 2012
-	10.000
-	58.600

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>
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**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

	FY 2011	FY 2012
Congressional Add Subtotals for Project: 63665A	-	68.600
Congressional Add Totals for all Projects	-	68.600

**Change Summary Explanation**

FY11: Other Adjustments include -0.251 Congressional General Reductions

In FY 2012, Congress added \$10 million for Program Increase.

In FY 2012, Congress transferred \$58.6 million from JIEDDO to PE 0305205F, Endurance Unmanned Aerial Vehicles, for the Blue Devil 1 program. Those funds have been subsequently moved from PE 0305205F to PE 0603203F for execution.

Decrease in FY 2013 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				PE 0603203F: <i>Advanced Aerospace Sensors</i>				63665A: <i>Advanced Aerospace Sensors Technology</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
63665A: <i>Advanced Aerospace Sensors Technology</i>	22.113	96.044	16.269	-	16.269	15.015	12.809	15.773	15.209	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, reconnaissance (ISR), target, and attack radar applications in both manned and unmanned platforms, including electro-optical sensors and electronic counter-countermeasures for radars. It provides aerospace platforms with the capability to precisely detect, track, and target both airborne (conventional and low radar cross-section) and ground-based, high-value, time-critical targets in adverse clutter and jamming environments. Project activities include developing multi-function radio-frequency systems including radar and electronic warfare technology. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Major Thrust 1.	6.714	6.624	1.621
<b>Description:</b> Develop and demonstrate technologies to provide precision position and timing information to enable distributed, layered sensing on large air and space vehicles in Global Positioning System (GPS) degraded/denied environments. Develop technologies to maximize positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Simulate, develop, and demonstrate integrated navigation warfare technologies, to establish and maintain a military advantage in satellite-based navigation.			
<b>FY 2011 Accomplishments:</b> Designed reduced size, weight, and power for precision time, position, and velocity sensor consisting of a single integrated GPS and inertial sensor for stringent installation requirements characteristic of small remotely piloted aircraft (RPA) appropriate for distributed, layered sensing. Developed reference optimization components necessary to support bi-static and multi-static radar technologies. Evaluated progress and determined next spiral requirements. Demonstrated a constructive systems engineering model to assess assured reference techniques in terms of measures of performance and warfighter utility.			
<b>FY 2012 Plans:</b> Develop strategies to optimize reference technologies for distributed sensing missions. Explore alternatives when GPS is degraded or denied. Reduce size, weight, and power of inertial components. Enhance precision of GPS and non-GPS reference technologies. Continue development of reference optimization components necessary to support bi-static and multi-static radar technologies. Continue to evaluate progress and determine next spiral requirements.			
<b>FY 2013 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>	<b>PROJECT</b> 63665A: <i>Advanced Aerospace Sensors Technology</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Decrease in FY 2013 funding is due to higher Department of Defense priorities. Continue to develop strategies to optimize reference technologies for distributed sensing missions. Maintain/enhance performance while reducing size, weight, and power. Continue development of reference optimization components necessary to support bi-static and multi-static radar technologies.				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Conduct research and development for the advancement of passive and active RF sensors; including phenomenology, modeling and simulation, algorithm development, and experimentation. Note: In FY12 and out, this effort moves to PE 0602204F, Aerospace Sensors, Project 627622, Major Thrust 2.</p> <p><b>FY 2011 Accomplishments:</b> Utilized new multiple input-multiple output (MIMO) technology and waveform diversity techniques to provide a new degree of freedom to be leveraged in RF electronic warfare. Performed modeling, algorithm development, and experimentation in the area of RF Tomography for imaging and apply techniques to Ground Penetrating Radar (GPR) for deeply buried targets.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Plans:</b> N/A</p>		0.961	-	-
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets.</p> <p><b>FY 2011 Accomplishments:</b> Performed systems engineering studies on open RF systems architectures to support commonality among RF components. Developed and tested low band (UHF) structural aperture, and an active RF sensor resource management tool. Completed dismount detection systems engineering analysis and demonstration.</p> <p><b>FY 2012 Plans:</b> Initiate test and evaluation of dismount radar detection back end and algorithms in conjunction with the outdoor range. Initiate persistent multiple intelligence (multi-INT) sources layered sensing demonstration. Continue development of modular RF backend (demonstration of open systems architecture) for combined radar and signals intelligence (SIGINT) processing for eventual</p>		8.171	15.927	8.844



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>	<b>PROJECT</b> 63665A: <i>Advanced Aerospace Sensors Technology</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>integration into the outdoor range. Provide systems engineering for development of integrated sensor for high altitude ISR. Initiate support and risk reduction efforts for a high altitude radar flight demonstration.</p> <p><b>FY 2013 Plans:</b> Complete development of modular RF backend (demonstration of open systems architecture) for combined radar and signals intelligence (SIGINT) processing and integrate into the outdoor range. Continue development and testing of a wide area staring radar.</p>				
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop advanced techniques and prototype passive RF sensors to intercept, collect, locate and track enemy RF sensor systems for intelligence, reconnaissance and surveillance of air and ground targets.</p> <p><b>FY 2011 Accomplishments:</b> Developed system engineering and flight test plan for passive multistatic radar flight demonstration. Developed Small remotely piloted aircraft (RPA) direction finding and geolocation system for VHF and UHF signals using in-house receivers and equipment to collect data and develop algorithms. Develop advanced electromagnetic methods for detecting difficult targets.</p> <p><b>FY 2012 Plans:</b> Complete system engineering and perform initial flight test of multistatic radar using existing aperture and receiver components. Collect flight data for small RPA direction finding and geolocation system process data using multiple algorithms. Demonstrate advanced electromagnetic methods for detecting difficult targets.</p> <p><b>FY 2013 Plans:</b> Complete flight test data collection of passive multistatic radar process data and develop algorithms for future multistatic radar systems.</p>		3.902	3.606	3.675
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Develop radio frequency (RF) and electro-optical (EO) sensor technology to detect, locate, and identify air and ground targets at long ranges, including those that are low-observable, or use deception or camouflage.</p> <p><b>FY 2011 Accomplishments:</b> Performed concept validation and signature utility experiments for long-range multi-spectral/polarimetric and synthetic aperture laser radar imaging. Conducted signature collection experiments with multi-spectral/polarimetric imaging systems to assess military utility. Began laboratory and field experiments for mitigating primary risk areas associated with synthetic aperture laser radar imaging from airborne platforms.</p> <p><b>FY 2012 Plans:</b></p>		0.771	0.826	2.129

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>	<b>PROJECT</b> 63665A: <i>Advanced Aerospace Sensors Technology</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013
<p>Perform concept validation and signature utility experiments for long-range synthetic aperture laser radar imaging. Continue laboratory and field experiments for mitigating primary risk areas associated with synthetic aperture laser radar imaging from airborne platforms. Initiate development of master oscillator technology.</p> <p><b>FY 2013 Plans:</b> Refine performance and signature models to validated requirements and concept of operations for long range synthetic aperture laser radar imaging. Continue laboratory and field experiments for mitigating primary risk areas associated with synthetic aperture laser radar imaging from airborne platforms.</p>			
<p><b>Title:</b> Major Thrust 6.</p> <p><b>Description:</b> Develop electro-optical sensing technologies for surveillance, tracking, and identification of dynamic targets in urban areas from manned and unmanned platforms.</p> <p><b>FY 2011 Accomplishments:</b> Performed concept demonstration experiments, beginning with ground-based experiments, for exploiting novel temporal, spectral, and polarimetric discrimination based on infrared sensors to rapidly detect, locate, identify, and characterize battlefield targets and events in urban areas. Leveraged large format, infrared focal plane array technology developed under other component development projects and assessed utility for high altitude and space platforms.</p> <p><b>FY 2012 Plans:</b> Continue concept demonstration experiments for exploiting infrared persistent surveillance imagery to detect, track, and characterize targets in urban areas. Perform utility assessment experiments to quantify system performance, analyze human perception performance and develop image processing techniques. Continue proof-of-concept development of large format infrared camera technology for distributed airborne surveillance.</p> <p><b>FY 2013 Plans:</b> N/A. Effort terminated due to higher Department of Defense priorities.</p>	1.594	0.461	-
<b>Accomplishments/Planned Programs Subtotals</b>	22.113	27.444	16.269

	FY 2011	FY 2012
<b>Congressional Add:</b> Program Increase	-	10.000
<b>FY 2011 Accomplishments:</b> N/A		
<b>FY 2012 Plans:</b> Conduct Congressionally-directed effort for Program Increase.		
<b>Congressional Add:</b> Blue Devil 1	-	58.600

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>	<b>PROJECT</b> 63665A: <i>Advanced Aerospace Sensors Technology</i>
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	<b>FY 2011</b>	<b>FY 2012</b>
<i>FY 2011 Accomplishments:</i> N/A		
<i>FY 2012 Plans:</i> Support Blue Devil 1 technology demonstration in theater.		
<b>Congressional Adds Subtotals</b>	-	68.600

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Sensors</i>	<b>PROJECT</b> 6369DF: <i>Target Attack and Recognition Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
6369DF: <i>Target Attack and Recognition Technology</i>	19.992	25.622	21.388	-	21.388	16.351	16.999	17.726	19.466	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	2.179	4.753	0.516
<b>Description:</b> Develop and demonstrate an automatic target recognition capability integrated with advanced geo-registration techniques and innovative change detection algorithms.			
<b>FY 2011 Accomplishments:</b> Determined the state-of-the-art technology capabilities and spirally developed enhancements to automatic target recognition, automatic target cueing, geo-registration, and change detection technology to meet warfighter needs. Conducted the assessment and enhancement of technology supporting time-critical targeting systems in the Air Force automatic target recognition test and evaluation facility. Conducted spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Enhanced the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced time-critical targeting capabilities. Conducted spiral development and assessment of time-critical targeting and advanced target tracking technologies required to meet warfighter requirements. Executed a laboratory demonstration of technology developed to date.			
<b>FY 2012 Plans:</b>			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Continue assessment and enhancement of technology supporting time-critical targeting systems for Planning &amp; Direction, Collection, Processing &amp; Exploitation, Analysis &amp; Production, and Dissemination (PCPAD)Experimentation. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Enhance the Air Force automatic target recognition test and evaluation facility and datasets as required to support enhanced PCPAD capabilities.</p> <p><b>FY 2013 Plans:</b> Continue to spirally develop enhancements to automatic target recognition, automatic target cueing, geo-registration, and change detection technology to meet warfighter needs. Continue assessment and enhancement of technology supporting time-critical targeting systems in automatic target recognition. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced time-critical targeting capabilities. Continue spiral development and assessment of time-critical targeting and advanced target tracking technologies required to meet warfighter requirements.</p>				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop an advanced suite of sensors with automatic target recognition, fusion, and target tracking, all working in concert to provide a high-confidence identification capability.</p> <p><b>FY 2011 Accomplishments:</b> Identified candidate technologies to address deficiencies to improve aimpoint tracking, electro-optical automatic target recognition, synthetic aperture radar automatic target recognition, and the multi-sensor fusion algorithms. Predicted performance of the integrated technologies and system. Enhanced phenomenological modeling, target, and scenario databases and exploitation tools necessary to support technology development. Assessed the maturity of applicable technology via the Air Force automatic target recognition test and evaluation facility and other sensor test facilities.</p> <p><b>FY 2012 Plans:</b> Continue to identify candidate technologies to address deficiencies to improve aimpoint tracking, electro-optical automatic target recognition, synthetic aperture radar automatic target recognition, and the multi-sensor fusion algorithms. Predict performance of the integrated technologies and system. Enhance phenomenological modeling, target, and scenario databases and exploitation tools necessary to support technology development. Assess maturity of applicable technology.</p> <p><b>FY 2013 Plans:</b></p>		5.330	6.175	3.042

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Continue to identify candidate technologies to address deficiencies to improve electro-optical automatic target recognition, synthetic aperture radar automatic target recognition, and multi-sensor fusion algorithms.				
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop an "identify friend, foe, or neutral" air-to-ground capability using cooperative and non-cooperative identification techniques.</p> <p><b>FY 2011 Accomplishments:</b> Began development of physics-based signature exploitation, modeling methods, and signal processing for feature-based recognition and fusion and applied these methods to sensor design to enable performance-based sensing. Began development of an integrated radar sensor signature exploitation and signal processing analysis capability for recognition applications including staring radar, Combat Identification (CID), Space Situational Awareness (SSA), measurement and signature intelligence (MASINT), and ISR applications. Developed efficient methods for collecting and processing radar sensor data for recognition. Began development of methods to analyze salient features to aid in the prediction, analysis, and processing capability as a function of sensor design parameters for performance-driven sensing. Developed a loosely coupled capability for multi-sensor measurement, processing, modeling, and analysis methods to support target recognition database development efforts and MASINT applications.</p> <p><b>FY 2012 Plans:</b> Continue development of physics-based signature exploitation, modeling methods, and signal processing for feature-based recognition and fusion and apply these methods to sensor design to enable performance-based sensing. Continue development of an integrated radar sensor signature exploitation and signal processing analysis capability for recognition applications including staring radar, CID, SSA, MASINT, and ISR applications. Continue to develop efficient methods for collecting and processing radar sensor data for recognition. Continue development of methods to analyze salient features to aid in the prediction, analysis, and processing capability as a function of sensor design parameters for performance-driven sensing. Continue to develop a loosely coupled capability for multi-sensor measurement, processing, modeling, and analysis methods to support target recognition database development efforts and MASINT applications.</p> <p><b>FY 2013 Plans:</b> Effort terminated due to higher Department of Defense priorities.</p>		1.005	0.977	-
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems.</p> <p><b>FY 2011 Accomplishments:</b></p>		3.542	4.776	7.807

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Conducted spiral development and assessment of multi-sensor automatic target recognition fusion algorithms. Conducted assessment of technology supporting intelligence, surveillance, reconnaissance, strike, and weapon systems using the Air Force automatic target recognition test and evaluation facility. Conducted spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Began development of signature science for automatic target recognition database development. Developed an automatic target recognition fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhanced the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities. Determined technology shortfalls and developed automatic target recognition fusion technologies to overcome these shortfalls. Executed a laboratory demonstration of technology developed to date.</p> <p><b>FY 2012 Plans:</b> Continue spiral development and assessment of multi-sensor automatic exploitation algorithms. Continue assessment of technology supporting intelligence, surveillance, and reconnaissance systems. Continue development of an automatic target recognition fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability. Determine technology shortfalls and develop automatic target recognition fusion technologies to overcome these shortfalls.</p> <p><b>FY 2013 Plans:</b> Continue spiral development and assessment of multi-sensor automatic exploitation algorithms in support of PCPAD. Continue assessment of technology supporting intelligence, surveillance, and reconnaissance systems. Continue development of an automatic target recognition fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability for PCPAD. Determine technology shortfalls and develop automatic target recognition fusion technologies to overcome these shortfalls.</p>				
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Develop wide angle, continuous staring, multi-sensor/wavelength sensing and automated exploitation technology to detect, track, and identify targets over large areas at low sensor update rates.</p> <p><b>FY 2011 Accomplishments:</b> Developed, integrated, and tested to technology readiness level (TRL) 4, the next spiral engineering model of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the previous demonstration. Integrated, demonstrated, and tested the enhanced, TRL 4, wide angle, continuously-staring component technologies via a combination of exercises and scientific analyses in the Air Force automatic target recognition test and evaluation facility. Conducted spiral development of wide angle, continuous staring exploitation algorithms, phenomenological</p>		2.615	3.771	6.225

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>modeling, target, and scenario databases necessary to support transition to the warfighter. Increased TRL to 4, demonstrated in a laboratory scenario, and evaluated results.</p> <p><b>FY 2012 Plans:</b> Develop, integrate, and test the next spiral engineering model of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the previous demonstration. Integrate, demonstrate, and test the enhanced wide angle, continuously-staring component technologies via a combination of exercises and scientific analyses. Continue spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target, and scenario databases necessary to support transition to the warfighter.</p> <p><b>FY 2013 Plans:</b> Develop, integrate, and test the next spiral engineering model of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the previous demonstration. Continue to integrate, demonstrate, and test the enhanced wide angle, continuously-staring component technologies via a combination of exercises and scientific analyses. Continue spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target, and scenario databases necessary to support transition to the warfighter.</p>				
<p><b>Title:</b> Major Thrust 6.</p> <p><b>Description:</b> Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets.</p> <p><b>FY 2011 Accomplishments:</b> Integrated, demonstrated, and tested real-time, wide angle, continuously-staring high band (X-Band) RF technology via a combination of exercises and scientific analyses in the Air Force automatic target recognition test and evaluation facility, increasing the TRL to 5, and demonstrated in a militarily significant scenario. Evaluated results, and began transition plan. Performed systems engineering for improved dual band (UHF/X) RF wide-angle, continuously-staring system.</p> <p><b>FY 2012 Plans:</b> Continue systems engineering and initiate development of dual-band wide-angle, continuously staring hardware and identify platform integration.</p> <p><b>FY 2013 Plans:</b> Complete development of dual-band system, and integrate on to identified platform.</p>		5.321	5.170	3.798
<b>Accomplishments/Planned Programs Subtotals</b>		19.992	25.622	21.388



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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	49.428	67.474	81.376	-	81.376	80.347	89.805	100.821	83.402	Continuing	Continuing
634920: <i>Flight Vehicle Tech Integration</i>	49.428	67.474	81.376	-	81.376	80.347	89.805	100.821	83.402	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project integrates and demonstrates advanced flight vehicle technologies that improve the performance and supportability of existing and future aerospace vehicles. System level integration brings together aerospace vehicle technologies along with avionics, propulsion, and weapon systems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational aircraft.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	53.588	67.474	64.058	-	64.058
Current President's Budget	49.428	67.474	81.376	-	81.376
Total Adjustments	-4.160	-	17.318	-	17.318
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.423	-			
• SBIR/STTR Transfer	-1.446	-			
• Other Adjustments	-1.291	-	17.318	-	17.318

**Change Summary Explanation**

FY11: Other Adjustments include -0.291 Congressional General Reductions and -1.000 Congressional Directed Transfers

FY13: increase due to higher Air Force priorities in flight and ground concepts for operationally responsive space concepts and acceleration of turbine engine activities.

**C. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1.	12.197	13.906	5.416	-	5.416

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
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**Description:** Develop autonomous flight controls for safe flight and cooperative operations between manned and remotely piloted air platforms.

**FY 2011 Accomplishments:**  
Furthered the development and demonstration process for situational awareness, autonomous control, and survivability technologies. Continued efforts for cooperative teaming of small remotely piloted aircraft in complex, low altitude environments. Continued development of autonomous launch and safe airspace interoperability technologies for multiple remotely piloted systems.

**FY 2012 Plans:**  
Develop and demonstrate technologies that provide situational awareness, autonomous control, and survivability for remotely piloted systems and manned platforms. Continue efforts for cooperative teaming of small remotely piloted platforms in complex, low altitude environments. Initiate testing of advanced control systems. Continue development of autonomous launch and safe airspace interoperability technologies for multiple remotely piloted systems.

**FY 2013 Base Plans:**  
Continue development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Demonstrate cooperative teaming of small unmanned platforms in complex, low altitude environments. Demonstrate autonomous launch and safe airspace interoperability for multiple remotely piloted systems. Decrease in FY 2013 due to higher Department of Defense priorities.

**FY 2013 OCO Plans:**  
N/A

<b>Title:</b> Major Thrust 2.	0.567	11.680	59.004	-	59.004
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**Description:** Develop, simulate, and demonstrate integrated technologies to improve the performance of aerospace platform capabilities.

**FY 2011 Accomplishments:**  
Continued work to develop and demonstrate flow control for reducing acoustic loading and enhancing weapon separation from future strike platforms.

**FY 2012 Plans:**

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Continue work to develop and demonstrate flow control for reducing acoustic loading and enhancing weapon separation from future strike platforms. Continue development efforts for cargo type platforms. Begin combined inlet and large bypass ratio fan demonstration.</p> <p><b>FY 2013 Base Plans:</b> Develop and assess detailed integrated flight and ground systems concepts for operationally responsive space lift. Develop a subscale vehicle to demonstrate the rocketback maneuver for reusable space access. Initiate efforts for precision air delivery capability for legacy mobility aircraft. Initiate development of advanced engine system design, integration, evaluation, interface control assessment, and testing to mature adaptive turbine engine technologies for advanced air vehicles (accelerate turbine engine activity to meet follow on activity need date).</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Develop aircraft structures that have embedded components, which were previously separate components attached to the air platforms.</p> <p><b>FY 2011 Accomplishments:</b> Completed assessment of test results for electronically scanned antenna array embedded in a load-bearing structure. Flight tested antenna integration into load-bearing structures. Initiated demonstration efforts for reliability of unitized multi-role structures. Demonstrated key high altitude persistent Intelligence, Surveillance, and Reconnaissance technologies.</p> <p><b>FY 2012 Plans:</b> Flight test of antenna integration into load-bearing structures. Initiate demonstration efforts for reliability of unitized multi-role structures. Demonstrate key high altitude persistent Intelligence, Surveillance, and Reconnaissance technologies.</p> <p><b>FY 2013 Base Plans:</b> Continue flight test of antenna integration into load-bearing structures. Complete demonstrations of key high altitude persistent Intelligence, Surveillance, and Reconnaissance technologies. Complete the demonstration of low band structurally integrated arrays and persistent multi-Intelligence platforms. Develop passive flow control</p>	18.044	22.169	9.513	-	9.513

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
improvements for enhanced aero efficiency of legacy aircraft. Decrease in FY 2013 due to higher Department of Defense priorities.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.  <b>Description:</b> Develop adaptive structures to provide in-flight modifications offering improved performance.  <b>FY 2011 Accomplishments:</b> Furthered demonstration of technologies necessary for reusable hypersonic vehicles. Assessed integrated structural health management for lightweight remotely piloted air vehicles from subsonic to hypersonic speeds. Developed and assessed detailed integrated flight and ground systems concepts for operationally responsive space lift.  <b>FY 2012 Plans:</b> Further demonstrate technologies necessary for reusable hypersonic vehicles. Assess integrated structural health management for lightweight remotely piloted air vehicles from subsonic to hypersonic speeds. Develop and assess detailed integrated flight and ground systems concepts for operationally responsive space lift.  <b>FY 2013 Base Plans:</b> Continue the development of integrated system health management and adaptive guidance and control for aerospace vehicles. Complete structural health management ground demonstration for reusable space access vehicle. Decrease in FY 2013 due to higher Department of Defense priorities.  <b>FY 2013 OCO Plans:</b> N/A	11.064	11.627	1.139	-	1.139
<b>Title:</b> Major Thrust 5.  <b>Description:</b> Develop, simulate, and demonstrate integrated technologies to enable, and improve the performance of high-speed and hypersonic air vehicles.  <b>FY 2011 Accomplishments:</b>	7.556	8.092	6.304	-	6.304

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: <i>Aerospace Technology Dev/Demo</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continued efforts related to hypersonic ablation /shape-change measurement. Initiated work for expendable and reusable hypersonic air-breathing concepts.					
<b><i>FY 2012 Plans:</i></b> Continue efforts related to hypersonic ablation /shape-change measurement and prediction capabilities. Conduct hypersonic flight experiments. Continue efforts to study potential applications for utilizing high speed vehicles in Intelligence, Surveillance, and Reconnaissance and strike missions.					
<b><i>FY 2013 Base Plans:</i></b> Continue to demonstrate technologies necessary for reusable hypersonic vehicles and high-speed weapons and weapon systems. Continue to advance high temperature materials and structures for hypersonic vehicles. Continue small scale flight testing of high-speed flying experiments.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	49.428	67.474	81.376	-	81.376

<b>D. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**E. Acquisition Strategy**

Not Applicable.

**F. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	129.925	120.924	151.152	-	151.152	153.221	151.998	167.798	157.799	Continuing	Continuing
632480: <i>Aerospace Fuels</i>	9.091	6.768	3.581	-	3.581	2.452	4.550	4.573	4.560	Continuing	Continuing
633035: <i>Aerospace Power Technology</i>	5.021	5.746	3.067	-	3.067	7.520	9.892	8.944	9.601	Continuing	Continuing
634921: <i>Aircraft Propulsion Subsystems Int</i>	40.066	17.709	77.716	-	77.716	68.076	52.129	68.848	68.821	Continuing	Continuing
634922: <i>Space &amp; Missile Rocket Propulsion</i>	29.357	27.596	22.446	-	22.446	24.061	24.388	27.598	26.631	Continuing	Continuing
635098: <i>Advanced Aerospace Propulsion</i>	12.744	30.117	9.553	-	9.553	18.811	42.427	39.140	29.523	Continuing	Continuing
63681B: <i>Advanced Turbine Engine Gas Generator</i>	33.646	32.988	34.789	-	34.789	32.301	18.612	18.695	18.663	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, and rocket propulsion, as well as electrical power thermal management, and fuels. The program has six projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Aerospace Fuels project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. The Aerospace Power Technology project develops and demonstrates power and thermal management systems for weapons and aircraft as part of energy optimized aircraft development. The Aerospace Propulsion Subsystems Integration project integrates the engine cores demonstrated in the Advanced Turbine Engine Gas Generator project with low-pressure components into demonstrator engines. The Space and Missile Rocket Propulsion project develops and demonstrates innovative rocket propulsion technologies, propellants, manufacturing techniques. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). The Advanced Turbine Engine Gas Generator project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. Portions of the Aerospace Fuels, Advanced Turbine Engine Gas Generator, and Aerospace Propulsion Subsystems Integration projects support adaptive cycle technology demonstrations which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>
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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	136.135	120.953	113.398	-	113.398
Current President's Budget	129.925	120.924	151.152	-	151.152
Total Adjustments	-6.210	-0.029	37.754	-	37.754
• Congressional General Reductions	-	-0.029			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.494	-			
• Other Adjustments	-2.716	-	37.754	-	37.754

**Change Summary Explanation**

FY11: Other Adjustments include -0.716 Congressional General Reductions and -2.000 Congressional Directed Transfers

FY13: Increase due to higher Air Force priorities for adaptive turbine engine technologies

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>				<b>PROJECT</b> 632480: <i>Aerospace Fuels</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
632480: <i>Aerospace Fuels</i>	9.091	6.768	3.581	-	3.581	2.452	4.550	4.573	4.560	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project evaluates and demonstrates improved hydrocarbon fuels, unique/alternate fuels and advanced, novel aerospace propulsion technologies for Air Force applications; including high-speed/hypersonic flight and technologies to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The advanced fuel emphasis is on demonstrating new thermally stable, high-heat sink, and controlled chemically reacting fuels for a conventional turbine engine, turbine-based combined cycle engines, and other advanced propulsion systems. The project also evaluates and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. The advanced propulsion emphasis is on demonstrating concepts for combined cycle, ramjet, and scramjet engines. A portion of this project supports the demonstration of adaptive cycle technologies. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated adaptive engine cycles for high efficiency and ultra efficient turbine engine technologies integrated power/thermal management systems that included cooled cooling air systems, as well as approaches to deoxygenate fuel to improve thermal stability.</p> <p><b>FY 2012 Plans:</b> Demonstrate advanced fuel-based turbine engine cooling approaches. Note: In FY 2012, efforts in this thrust are decreased due to higher Air Force (AF) priorities.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	2.866	1.000	-	-	-
<p><b>Title:</b> Major Thrust 2.</p>	1.196	1.000	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>		<b>PROJECT</b> 632480: <i>Aerospace Fuels</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
<b>Description:</b> Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/particulate emissions from gas turbine engines.					
<b>FY 2011 Accomplishments:</b> Assessed fuel structure/combustion performance relationship in high pressure combustor. Assessed effectiveness of chemical kinetic models for jet fuels to match high pressure combustor flame data.					
<b>FY 2012 Plans:</b> Demonstrate state-of-the-art soot/particulate diagnostics in full scale engine testing.					
<b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop and demonstrate enhancements to fuel system technology.					
<b>FY 2011 Accomplishments:</b> Developed advanced fuel catalyst and composition approaches to achieve 2nd generation endothermic fuel heat sink goals.					
<b>FY 2012 Plans:</b> Demonstrate effective structural cooling of 2nd generation endothermic fuels for hypersonic vehicles.					
<b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	1.043	1.000	-	-	-
	1.097	0.770	3.581	-	3.581

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Modeled spread of biological materials (fungus, bacteria, etc.) through fuel handling systems. Demonstrated advanced additives for mitigation of biological growth.</p> <p><b>FY 2012 Plans:</b> Evaluate fuel compositional relationship to biological growth.</p> <p><b>FY 2013 Base Plans:</b> Demonstrate mitigation of biological growth in alternative fuels and commercial jet fuels in base-level fuel distribution systems.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Characterize and demonstrate the use of alternative hydrocarbon jet fuel to comply with Air Force certifications and standards for jet fuels.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated biomass-derived fuel and specification requirements, focusing on yield potential from varying feedstocks. Studied greenhouse gas footprint assessment for alternative aviation fuels.</p> <p><b>FY 2012 Plans:</b> Demonstrate improved alternative fuel combustion evaluation process to enable more rapid certification. Evaluate fully-synthetic biofuels in "fit-for-purpose" and rig testing to demonstrate durability.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	2.889	2.998	-	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	9.091	6.768	3.581	-	3.581

<b>C. Other Program Funding Summary (\$ in Millions)</b>			FY 2013	FY 2013	FY 2013						Cost To
<u>Line Item</u>	FY 2011	FY 2012	Base	OCO	Total	FY 2014	FY 2015	FY 2016	FY 2017	Complete	Total Cost
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633035: <i>Aerospace Power Technology</i>	5.021	5.746	3.067	-	3.067	7.520	9.892	8.944	9.601	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates electrical power, thermal management, and distribution for aerospace applications. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs for manned and remotely piloted aircraft. The electrical power system components developed are projected to provide a two- to five-fold improvement in aircraft reliability and maintainability, and a reduction in power system weight. This project is integrated into energy optimized aircraft efforts and power and thermal programs. This project also develops and demonstrates electrical power and thermal management technologies to enable solid state high power density sources for directed energy weapons.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop electrical power and thermal management component subsystem technologies for integration with directed energy weapons (DEW) to deliver high power for DEW operation.</p> <p><b>FY 2011 Accomplishments:</b> Supported development of energy storage, power conditioning, and thermal management subsystems to support flight demonstration of a high energy laser.</p> <p><b>FY 2012 Plans:</b> Support integration of power and thermal management subsystems for flight demonstration of a high energy laser.</p> <p><b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	0.250	0.200	-	-	-
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for integration into high power aircraft.</p> <p><b>FY 2011 Accomplishments:</b></p>	4.287	5.055	3.067	-	3.067

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Integrated, fabricated, and modified high temperature, energy optimized power and thermal management components. Integrated subsystems (including rugged/robust power electronics, motor controls, high performance electric actuators, and adaptive power and thermal management technologies) and performed integrated system level evaluation testing. Performed system modifications as necessary to demonstrate that integrated subsystems meet design criteria and performance objectives.					
<b>FY 2012 Plans:</b> Demonstrate robust, high power, high temperature power and thermal management subsystems as part of hardware in the loop validation and verification of system level energy optimized air platform models.					
<b>FY 2013 Base Plans:</b> Demonstrate adaptive power and thermal management subsystems for next generation air platforms based on system level energy optimized air platform models.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop hybrid electrical power and thermal management components and subsystem technologies for special purpose applications, enabling long endurance small remotely piloted aircraft (RPA).					
<b>FY 2011 Accomplishments:</b> Developed and fabricated energy optimized, lightweight, hybrid electrical power and thermal management subsystems for increased endurance RPA and ground based special purpose applications.					
<b>FY 2012 Plans:</b> Demonstrate ruggedized high endurance small RPA hybrid power and thermal management subsystems.					
<b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>					
	0.484	0.491	-	-	-
	5.021	5.746	3.067	-	3.067



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>				<b>PROJECT</b> 634921: <i>Aircraft Propulsion Subsystems Int</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
634921: <i>Aircraft Propulsion Subsystems Int</i>	40.066	17.709	77.716	-	77.716	68.076	52.129	68.848	68.821	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The Aerospace Propulsion Subsystems Integration (APSI) project includes demonstrator engines for manned systems and concept and efficient small-scale propulsion for remotely piloted aircraft and cruise missile applications. The demonstrator engines integrate the core (high-pressure spool) technology developed under the Advanced Turbine Engine Gas Generator project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, mechanical systems, exhaust nozzles, and augmentors. Additionally, this project includes activities to improve propulsion safety and readiness. This project also focuses on integration of inlets, nozzles, engine/airframe compatibility, and power and thermal management subsystems technologies. The APSI project provides aircraft with potential for longer range and higher cruise speeds with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost, and improved survivability, resulting in increased mission effectiveness. Technologies developed are applicable to sustained high-speed vehicles and responsive space launch. The APSI project is focused on improving propulsion capabilities while at the same time reducing the cost of ownership. Anticipated technology advances include turbine engine improvements providing approximately twice the range for a sustained supersonic combat aircraft, doubling the time on station with 10 times the power output for surveillance aircraft and propulsion for a high speed supersonic missile with double the range for time sensitive targets. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<b>Title:</b> Major Thrust 1.	7.267	1.800	0.500	-	0.500
<b>Description:</b> Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines to improve durability, supportability, and affordability of AF aircraft.					
<b>FY 2011 Accomplishments:</b> Completed detailed design and began fabricate hardware for advanced features for durable fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories, to include advanced cooling design for low pressure turbine blades, health monitoring, light weight externals, and repair validation.					
<b>FY 2012 Plans:</b>					

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Continue fabrication of low spool engine components. Investigate inlet and exhaust interactions. Continue to develop controls and accessories, health monitoring technologies, and light weight external components. Continue to assess and validate repair techniques.					
<b>FY 2013 Base Plans:</b> Investigate inlet and exhaust interactions. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines.					
<b>FY 2011 Accomplishments:</b> Continued fabrication and began assembly of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Continued preliminary design for a high bypass/high overall pressure ratio engine technologies for improved fuel consumption.					
<b>FY 2012 Plans:</b> Complete assembly and instrumentation of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Conduct experimental testing of engine technologies. Continue preliminary design of high bypass/high overall pressure ratio engine technologies for improved fuel consumption. Note: In FY 2012, efforts in this thrust are decreased due to higher AF priorities.					
<b>FY 2013 Base Plans:</b> Finish assembly and instrumentation of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
	24.805	14.709	9.167	-	9.167
	7.994	1.200	15.916	-	15.916

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>		<b>PROJECT</b> 634921: <i>Aircraft Propulsion Subsystems Int</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Description:</b> Design, fabricate, and test component technologies for limited life engines to improve the performance, durability, and affordability of missile and remotely piloted aircraft engines.</p> <p><b>FY 2011 Accomplishments:</b> Conducted detailed design of a higher specific thrust, low-cost expendable turbine engine for improved fuel efficiency to significantly improve range. Conducted detailed design of advanced fan, advanced low spool turbine spool, and advanced engine components for fuel efficient subsonic unmanned turbofan engines.</p> <p><b>FY 2012 Plans:</b> Complete detailed design and initiate fabrication of components of a higher specific thrust, low-cost expendable turbine engine for improved fuel efficiency to significantly improve range. Continue detailed design of advanced fan, advanced low spool turbine spool, and advanced engine components for fuel efficient subsonic unmanned turbofan engines. Note: In FY 2012, efforts in this thrust are decreased due to higher AF priorities.</p> <p><b>FY 2013 Base Plans:</b> Complete assembly and instrumentation of supersonic, long endurance turbine engines. Complete critical technology rig testing and begin sea level testing of supersonic, long endurance turbine engines accelerate engine activity to meet follow on activity need date).</p>					
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> Complete preliminary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Perform augmentor/exhaust nozzle cold flow testing. Perform preliminary design of an advanced adaptive fan.</p>	-	-	52.133	-	52.133
<b>Accomplishments/Planned Programs Subtotals</b>	40.066	17.709	77.716	-	77.716

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 634921: <i>Aircraft Propulsion Subsystems Int</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>				634922: <i>Space &amp; Missile Rocket Propulsion</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
634922: <i>Space &amp; Missile Rocket Propulsion</i>	29.357	27.596	22.446	-	22.446	24.061	24.388	27.598	26.631	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery and components, low-cost space launch propulsion technologies, and advanced propellants for launch and orbit transfer propulsion. Additionally, this project develops technologies for the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion technologies for station-keeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion technologies, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program could improve the performance of expendable payload capabilities by approximately 20-50 percent and reduce launch, operations, and support costs by approximately 30 percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Technology advances could also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. Aging and surveillance efforts for solid rocket motors could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause. The efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense and often NASA.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop liquid rocket propulsion technology for current and future space launch vehicles.

**FY 2011 Accomplishments:**

Continued, through hot fire testing, the validation and verification of modeling and simulation tools developed for advanced cryogenic upper stage technologies. Continued development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continued sub-scale component testing to demonstrate hydrocarbon boost technologies. Continued material manufacturing scale-up effort to support hydrocarbon boost demonstration program.

**FY 2012 Plans:**

Complete the validation and verification of modeling and simulation tools developed for advanced cryogenic upper stage technologies. Continue development of hydrocarbon engine components for integration and

<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
22.210	20.860	19.680	-	19.680

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>		<b>PROJECT</b> 634922: <i>Space &amp; Missile Rocket Propulsion</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continue sub-scale preburner and turbine component testing to demonstrate hydrocarbon boost technologies. Continue ox-rich material manufacturing scale-up effort to support hydrocarbon boost demonstration program. Conduct component scale-up and characterization for advanced hydrocarbon engine technologies using fuels other than kerosene. Note: In FY 2012, funding is decreased due to higher Air Force priorities.					
<b>FY 2013 Base Plans:</b> Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continue sub-scale preburner and turbine component testing to demonstrate hydrocarbon boost technologies. Complete ox-rich material manufacturing scale-up effort to support hydrocarbon boost demonstration program.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Develop solar electric, electric, and monopropellant propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite maneuvering.					
<b>FY 2011 Accomplishments:</b> Initiated scale-up of micro propulsion technologies for spacecraft with the need for high mobility on orbit. Continued hardware scale-up and prepared to conduct testing of hardware for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Scaled-up next generation of chemical thrusters for spacecraft propulsion systems.					
<b>FY 2012 Plans:</b> Conduct scale-up of propulsion technologies for spacecraft with the need for high mobility on orbit. Complete hardware scale-up and conduct testing of hardware for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Build components for integration and demonstration of next generation of chemical thrusters for spacecraft propulsion systems.					
<b>FY 2013 Base Plans:</b> Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	3.696	3.748	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>		<b>PROJECT</b> 634922: <i>Space &amp; Missile Rocket Propulsion</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop and demonstrate missile propulsion and Post Boost Control Systems technologies for ballistic missiles.					
<b>FY 2011 Accomplishments:</b> Continued development of advanced missile propulsion technologies. Continued sub-scale component developments providing sub-scale validation of modeling and simulation tools.					
<b>FY 2012 Plans:</b> Continue development of advanced missile case, insulation, and nozzle technologies. Continue sub-scale component developments providing sub-scale validation of modeling and simulation tools. Complete propellant component development and transition into next generation integrated motor demonstration.					
<b>FY 2013 Base Plans:</b> Continue development of advanced missile case, insulation, and nozzle technologies. continue subscale component developments providing sub-scale validation of modeling and simulation tools. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b>FY 2013 OCO Plans:</b> N/A					
	2.409	2.017	1.587	-	1.587
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainty for individual motors, enabling motor replacement for cause.					
<b>FY 2011 Accomplishments:</b> Continued integration and full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies. Completed assessment of effort modeling critical defects in solid rocket motors.					
<b>FY 2012 Plans:</b>					
	1.042	0.971	1.179	-	1.179



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 634922: <i>Space &amp; Missile Rocket Propulsion</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Continue integration and full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies.  <b>FY 2013 Base Plans:</b> Continue integration and full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	29.357	27.596	22.446	-	22.446

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 635098: <i>Advanced Aerospace Propulsion</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635098: <i>Advanced Aerospace Propulsion</i>	12.744	30.117	9.553	-	9.553	18.811	42.427	39.140	29.523	Continuing	Continuing

**Note**

Note: In FY 2012, funding in this project is increased to complete scramjet engine flight demonstrations.

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates, via ground and flight tests, the scramjet propulsion cycle to a technology readiness level appropriate for full integration with other engine cycles (including turbine and rocket-based) to provide the Air Force with transformational military capabilities. The primary focus is on the hydrocarbon-fueled, scramjet engine. Multi-cycle engines will provide the propulsion systems for possible application to support aircraft and weapon platforms operating over the range of Mach 0 to 8+. Efforts include scramjet flow-path optimization to enable operation over the widest possible range of Mach numbers, active combustion control to assure continuous positive thrust (even during mode transition), robust flame-holding to maintain stability through flow distortions, and maximized volume-to-surface area to minimize the thermal load imposed by the high-speed engine. Thermal management plays a vital role in scramjet and combined cycle engines, including considerations for protecting low speed propulsion systems (e.g., turbine engines) during hypersonic flight.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8.</p> <p><b>FY 2011 Accomplishments:</b> Continued flight testing of a scramjet engine demonstrator. Analyzed flight test data and began preparing a final report. Demonstrated small- scale scramjet engine to Technology Readiness Level 6.</p> <p><b>FY 2012 Plans:</b> Complete flight testing of a scramjet engine demonstrator. Analyze flight test data and complete a final report. Develop and demonstrate tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Note: In FY 2012, efforts in this thrust are increased to complete scramjet engine flight demonstrations.</p> <p><b>FY 2013 Base Plans:</b> Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Complete component demonstration of tactically compliant cold start</p>	12.744	30.117	9.553	-	9.553

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 635098: <i>Advanced Aerospace Propulsion</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
system. Initiate design of flight weight scramjet engine cold start system, fuel system components, and advanced engine control system. Decrease in FY 2013 due to higher Department of Defense priorities.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	12.744	30.117	9.553	-	9.553

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>			<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>				
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>			PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>				63681B: <i>Advanced Turbine Engine Gas Generator</i>				
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
63681B: <i>Advanced Turbine Engine Gas Generator</i>	33.646	32.988	34.789	-	34.789	32.301	18.612	18.695	18.663	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, reparability, and maintainability can be assessed in a realistic engine environment. The gas generator, or core, is the basic building block of the engine and nominally consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental core engine demonstration validates engineering design tools and enhances rapid, low-risk transition of key engine technologies into engineering development, where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, ships, and responsive space launch. Component technologies are demonstrated in a core (sub-engine). This project also assesses the impact of low spool components (such as inlet systems, fans, low pressure turbines, and exhaust systems) and system level technologies (such as integrated power generators and thermal management systems) on core engine performance and durability in "core-centric engine" demonstration. The core performances of this project are validated on demonstrator engines in Project 4921 of this Program Element. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<b>Title:</b> Major Thrust 1.	20.290	19.790	15.322	-	15.322
<b>Description:</b> Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan/turbojet engines.					
<b>FY 2011 Accomplishments:</b> Continued hardware fabrication and initiate assembly of high temperature capable, durable compressor, combustor, and turbine for adaptive core engine. Completed detailed design and initiate fabrication of component technologies for a core-centric durability engine demonstration. Conducted fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Conducted preliminary design and initiate detailed design of system-level technologies and weapon systems integration on core engine performance.					
<b>FY 2012 Plans:</b> Complete hardware fabrication, assembly and experimental demonstration of high temperature capable, durable compressor, combustor, and turbine for adaptive core engine. Continue fabrication of component					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 63681B: <i>Advanced Turbine Engine Gas Generator</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>technologies and initiate assembly for a core-centric durability engine demonstration. Continue fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Conduct detailed design of system-level technologies and weapon systems integration on core engine performance.</p> <p><b>FY 2013 Base Plans:</b> Evaluate and conduct post demonstration assessment of high temperature capable, durable compressor, combustor, and turbine for adaptive core engine.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Design, fabricate, and demonstrate high overall pressure ratio cores to provide increased durability and affordability with lower fuel consumption for turbofan/turboshaft engines.</p> <p><b>FY 2011 Accomplishments:</b> Completed preliminary design of core for efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Continued selective risk reduction experimental demonstrations of RPA small versatile affordable advanced core engine. Continued detailed design and initiate fabrication of efficient small engine component technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness or uncooled turbine for use in RPA applications.</p> <p><b>FY 2012 Plans:</b> Initiate detailed design, fabrication and begin assembly and instrumentation of core for efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Continue selective risk reduction experimental demonstrations of RPA small versatile affordable advanced core engine. Continue fabrication of efficient small engine component technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling</p>	13.356	13.198	3.500	-	3.500

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 63681B: <i>Advanced Turbine Engine Gas Generator</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>effectiveness or uncooled turbine for use in RPA applications. Initiate conceptual design for advanced very efficient and very high pressure ratio core engine.</p> <p><b>FY 2013 Base Plans:</b> Continue detailed design, fabrication and begin assembly and instrumentation of core for efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Decrease in FY 2013 due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine core technologies.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Base Plans:</b> Conduct design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Perform power and thermal management system analysis and assessment.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	-	-	15.967	-	15.967
<b>Accomplishments/Planned Programs Subtotals</b>	33.646	32.988	34.789	-	34.789

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	<b>PROJECT</b> 63681B: <i>Advanced Turbine Engine Gas Generator</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	16.029	22.231	32.941	-	32.941	49.028	54.563	54.685	54.882	Continuing	Continuing
632432: <i>Defensive System Fusion Technology</i>	4.981	6.180	1.320	-	1.320	0.633	-	-	-	Continuing	Continuing
633720: <i>EW Quick Reaction Capabilities</i>	-	-	10.000	-	10.000	25.000	35.000	39.000	39.000	Continuing	Continuing
63431G: <i>RF Warning &amp; Countermeasures Tech</i>	3.686	5.403	15.508	-	15.508	19.493	15.009	11.091	11.156	Continuing	Continuing
63691X: <i>EO/IR Warning &amp; Countermeasures Tech</i>	7.362	10.648	6.113	-	6.113	3.902	4.554	4.594	4.726	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops and demonstrates technologies to support Air Force electronic combat warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift electronic combat applications in three project areas. The first project develops and demonstrates technologies for integrating electronic combat sensors and systems into a fused and seamless whole. The second project integrates and focuses research efforts in electronic warfare (EW), directed energy weapons (DEW), and cyber warfare to rapidly demonstrate a capability for rapid fielding. The third project develops and demonstrates advanced technologies for radio-frequency electronic combat suites. The fourth project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>				
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i>	PE 0603270F: <i>Electronic Combat Technology</i>				
BA 3: <i>Advanced Technology Development (ATD)</i>					

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	16.992	22.268	23.325	-	23.325
Current President's Budget	16.029	22.231	32.941	-	32.941
Total Adjustments	-0.963	-0.037	9.616	-	9.616
• Congressional General Reductions	-	-0.037			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.509	-			
• SBIR/STTR Transfer	-0.354	-			
• Other Adjustments	-0.100	-	9.616	-	9.616

**Change Summary Explanation**

FY11: Other Adjustments include -0.100 Congressional General Reductions

FY13: Project 633720, EW Quick Reaction Capabilities, was added to PE 0603270F, and funded at \$10 million in FY13, and \$148 million over the FYDP.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 632432: <i>Defensive System Fusion Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
632432: <i>Defensive System Fusion Technology</i>	4.981	6.180	1.320	-	1.320	0.633	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates technologies for integrating electronic combat sensors and electronic combat system fusion. It develops advanced algorithms and assessment techniques needed to evaluate and enable combat aircraft operations in multi-spectral threat and countermeasure environments. It also matures technologies required for command-and-control warfare, stand off jamming, and electronic support measures for the denial, disruption, and suppression of adversary air defense operations. Technologies include advanced components and techniques needed to jam enemy radars, advanced stand off jammer technologies, and electronic collection methods to inform field commanders of changes in the electronic environment.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust.	4.981	6.180	1.320
<b>Description:</b> Develop affordable radio-frequency and electro-optical emitter warning and electronic warfare (EW) battle management technologies, integrating EW and information operations.			
<b>FY 2011 Accomplishments:</b> Initiated a critical experiment to demonstrate synergistic EW and information operations (IO) techniques against a representative integrated air defense system. Initiated an effort to develop a virtual EW/IO battlespace environment for future project demonstrations, experiments, and assessments. Conducted a demonstration of electronic warfare battle management techniques and algorithms. Developed a distributed (multi-node) electronic support/electronic attack architecture.			
<b>FY 2012 Plans:</b> Increase maturity and perform demonstrations of electronic warfare battle management (EWBM) capabilities. Focus efforts on Distributed Electronic Attack concepts for specific threats and radar classes. Initiate effort in understanding and countering traditional and non-traditional targets in support of irregular warfare (IW). Continue an effort to develop a virtual EW/IO battlespace environment for future project demonstrations, experiments, and assessments.			
<b>FY 2013 Plans:</b> Continue development of Distributed Electronic Attack concepts for specific threats and radar classes.			
<b>Accomplishments/Planned Programs Subtotals</b>	4.981	6.180	1.320

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 632432: <i>Defensive System Fusion Technology</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 633720: <i>EW Quick Reaction Capabilities</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633720: <i>EW Quick Reaction Capabilities</i>	-	-	10.000	-	10.000	25.000	35.000	39.000	39.000	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project establishes a Joint Capabilities Office (JCO) to integrate and focus technology research efforts in Electronic Warfare (EW), Directed Energy Weapons (DEW), and Cyber Warfare. The JCO will coordinate and shape investments in emergent science and applied technologies to yield long-term non-kinetic dominance of the electromagnetic spectrum. This office will work with Component research and acquisition organizations to formulate innovative concepts, technologies and delivery systems; build engineering models at a highly accelerated pace; and sponsor field demonstrations of disruptive EW capabilities to outpace adversary efforts.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop disruptive EW and countermeasure concepts specifically selected for rapidly fieldable, high-impact effects and demonstrate them in an operational environment.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b> N/A</p> <p><b>FY 2013 Plans:</b> Initiate development of disruptive EW and countermeasure concepts specifically selected for rapidly fieldable, high-impact effects and demonstrate them in an operational environment.</p>	-	-	4.000
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Establish and maintain an all-source, physics-based, design-level, red-blue, comparative, threat-to-countermeasure database. The database will inform programmatic planning, highlight desirable research areas, and foster improved understanding of future concept contributions to EW warfighting capabilities.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b></p>	-	-	3.000

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 633720: <i>EW Quick Reaction Capabilities</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013
N/A			
<b>FY 2013 Plans:</b> Initiate development of an all-source, physics-based, design-level, red-blue, comparative, threat-to-countermeasure database.			
<b>Title:</b> Major Thrust 3	-	-	3.000
<b>Description:</b> Develop a core analytic function, supported by a simulation-based wargaming and engineering modeling capabilities, for evaluation, development, and demonstration of advanced EW, DEW, Cyber, and non-kinetic concepts to include special capability programs.			
<b>FY 2011 Accomplishments:</b> N/A			
<b>FY 2012 Plans:</b> N/A			
<b>FY 2013 Plans:</b> Initiate development of a core analytic function, supported by a simulation-based wargaming and engineering modeling capabilities, for evaluation, development, and demonstration of advanced EW, DEW, Cyber, and non-kinetic concepts to include special capability programs.			
<b>Accomplishments/Planned Programs Subtotals</b>	-	-	10.000

<b>C. Other Program Funding Summary (\$ in Millions)</b>							<b>Cost To</b>					
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
• N/A (1): N/A (1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 63431G: <i>RF Warning &amp; Countermeasures Tech</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
63431G: <i>RF Warning &amp; Countermeasures Tech</i>	3.686	5.403	15.508	-	15.508	19.493	15.009	11.091	11.156	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced technologies for radio-frequency electronic combat suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addresses technologies for missile/threat warning, radio-frequency receivers, electronic combat pre-processors, advanced sorting/pre-processing algorithms, and expert software for applications on existing and future electronic combat systems. Another major technology area focuses on the development and demonstration of subsystems and components for generating on-board/off-board radio-frequency countermeasure techniques. This includes the development of electronic countermeasures techniques, as well as advanced electronic countermeasures technologies such as antennas, power amplifiers, and preamplifiers.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Major Thrust.	3.686	5.403	15.508
<b>Description:</b> Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency (RF) threats associated with current and future aerospace weapon systems.			
<b>FY 2011 Accomplishments:</b> Initiated next-generation electronic attack techniques concept definition studies. Initiated a distributed tactical electronic combat receiver development effort. Demonstrated cognitive and adaptable electronic combat techniques and algorithms. Provided active electronic protection architecture concepts for transition.			
<b>FY 2012 Plans:</b> Demonstrate adaptable electronic attack (EA) technique concepts against a modeled threat environment. Initiate effort to develop a Network electronic support/electronic attack (ES/EA) Experiments Lab. Demonstrate a cognitive jammer system concept in a laboratory environment. Define and analyze proactive electronic protection (EP) concepts. Continue effort to focus on next generation RF threats and potential EW concepts.			
<b>FY 2013 Plans:</b> Increase in FY 2013 funding is due to an increased emphasis in this effort. Continue to demonstrate adaptable electronic attack (EA) technique concepts against a modeled threat environment. Continue to develop and demonstrate a cognitive jammer system concept in a laboratory environment. Continue to assess and analyze proactive electronic protection (EP) concepts. Continue effort to focus on next generation RF threats and potential EW concepts.			
<b>Accomplishments/Planned Programs Subtotals</b>	3.686	5.403	15.508

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 63431G: <i>RF Warning &amp; Countermeasures Tech</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 63691X: <i>EO/IR Warning &amp; Countermeasures Tech</i>
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COST (\$ in Millions)	FY 2013			FY 2013		FY 2014		FY 2015		FY 2016	FY 2017	Cost To Complete	Total Cost
	FY 2011	FY 2012	Base	OCO	Total	FY 2014	FY 2015	FY 2016	FY 2017				
63691X: <i>EO/IR Warning &amp; Countermeasures Tech</i>	7.362	10.648	6.113	-	6.113	3.902	4.554	4.594	4.726	Continuing	Continuing		

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical, infrared, and laser threats to aerospace platforms. Off-board (decoys and expendables) and on-board countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against infrared missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and electro-optical and infrared tracking systems used to direct electro-optical, infrared, and radar-guided missiles.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Major Thrust 1.	7.362	10.648	6.113
<b>Description:</b> Analyze the vulnerabilities of current infrared missile systems and future imaging infrared sensors. Develop advanced countermeasure system technologies to exploit vulnerabilities for use against infrared and electro-optical guided missile threats. Develop advanced optical and infrared sensor systems for airborne and space situational awareness and threat warning.			
<b>FY 2011 Accomplishments:</b> Developed, tested, and refined infrared countermeasures concepts and techniques against current and advanced threats including imaging threats. Demonstrated advanced concepts for full spectrum laser threat detection/geolocation for countermeasure hand-off. Evaluated the impact on countermeasures design, simulation and investigative processes presented by current and next generation seeker and sensor threats. Continued efforts to obtain imaging threats. Conducted Space Situational Awareness (SSA) sensor prototype experiments.			
<b>FY 2012 Plans:</b> Continue to develop, test, and refine infrared countermeasures concepts and techniques against current infrared missile systems and future advanced threat sensors. Continue development of surrogate imaging sensors, processors, and track algorithms to test and evaluate countermeasure concepts against advanced threat systems. Continue to develop new laser warning concepts and simulation capability to address emerging directed energy threats to provide situational awareness and threat warning. Initiate SSA sensor prototype experiment phase II.			
<b>FY 2013 Plans:</b> Continue to develop, test, and refine infrared countermeasures concepts and techniques against current infrared missile systems and future advanced threat sensors. Continue development of surrogate imaging sensors, processors, and track algorithms to test and evaluate countermeasure concepts against advanced threat systems. Perform advanced proactive infrared			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 63691X: <i>EO/IR Warning &amp; Countermeasures Tech</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
countermeasures (PIRCM) search, detect, and countermeasure research. Develop concepts for protection of postulated future threats to generation-6 aircraft including definition of component and subsystem requirements.			
<b>Accomplishments/Planned Programs Subtotals</b>	7.362	10.648	6.113

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	75.103	74.009	64.557	-	64.557	61.690	67.075	54.973	56.870	Continuing	Continuing
632181: <i>Spacecraft Payloads</i>	18.573	18.799	15.710	-	15.710	13.299	12.303	9.659	9.989	Continuing	Continuing
633834: <i>Integrated Space Technology Demonstrations</i>	36.556	35.143	13.828	-	13.828	13.933	22.653	24.206	25.297	Continuing	Continuing
634400: <i>Space Systems Protection</i>	4.464	4.475	5.047	-	5.047	6.469	7.217	7.416	7.587	Continuing	Continuing
634950: <i>Space Demonstration</i>	-	-	16.000	-	16.000	15.000	-	-	-	Continuing	Continuing
635021: <i>Space Systems Survivability</i>	3.610	3.249	2.907	-	2.907	3.097	3.526	3.552	3.634	Continuing	Continuing
635083: <i>Ballistic Missiles Technology</i>	5.053	5.216	5.081	-	5.081	5.377	6.214	6.260	6.404	Continuing	Continuing
63682J: <i>Spacecraft Vehicles</i>	6.847	7.127	5.984	-	5.984	4.515	3.662	3.880	3.959	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft vehicles, ballistic missiles, and space systems survivability. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i>	PE 0603401F: <i>Advanced Spacecraft Technology</i>
BA 3: <i>Advanced Technology Development (ATD)</i>	

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	83.705	74.636	75.715	-	75.715
Current President's Budget	75.103	74.009	64.557	-	64.557
Total Adjustments	-8.602	-0.627	-11.158	-	-11.158
• Congressional General Reductions	-	-0.627			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-2.511	-			
• SBIR/STTR Transfer	-1.568	-			
• Other Adjustments	-4.523	-	-11.158	-	-11.158

**Change Summary Explanation**

FY11: Other Adjustments include -0.933 Congressional General Reductions and -3.590 Congressional Directed Transfers

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 632181: <i>Spacecraft Payloads</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
632181: <i>Spacecraft Payloads</i>	18.573	18.799	15.710	-	15.710	13.299	12.303	9.659	9.989	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware, and software for advanced satellite surveillance operations. Future improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, this project merges advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop microelectronic devices, including radiation-hardened data processors and high-density hardened memories, advanced packaging technologies, and micro-electro-mechanical system components and applications.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated engineering model of high-density volatile memory. Continued multiprocessor architecture development. Initiated multiprocessor component development.</p> <p><b>FY 2012 Plans:</b> Complete development of Single Event Immune Reconfigurable Field Programmable Gate Array for flexible, cost-effective on-board processing in space. Develop multiprocessor components to increase on-orbit processing capability. Develop high-density volatile and non-volatile memory for increased on-orbit storage capability.</p> <p><b>FY 2013 Base Plans:</b> Continue to develop multiprocessor components to increase on-orbit processing capability. Continue to develop high-density volatile and non-volatile memory for increased on-orbit storage capability. Develop structured application specific integrated circuits for affordable space electronics.</p> <p><b>FY 2013 OCO Plans:</b></p>	6.037	7.274	7.047	-	7.047

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>		<b>PROJECT</b> 632181: <i>Spacecraft Payloads</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 2.					
<b>Description:</b> Develop satellite system technologies for spacecraft operations and for satellite control, precision navigation, formation flying, and proximity operations technologies.					
<b>FY 2011 Accomplishments:</b> Completed model of command, control, and communications systems, conducted engineering trades, and performed military utility analysis for space superiority. Continued rapid spacecraft development processes to include automated spacecraft design, rapid assembly, automated flight and ground software configuration, and expedited integration and test.					
<b>FY 2012 Plans:</b> Complete rapid spacecraft development processes for automated spacecraft design, rapid assembly, automated flight and ground software configuration, and expedited integration and test. Initiate second-generation plug-and-play ground testbed to fully test and demonstrate end-to-end flight ready spacecraft plug-and-play software and hardware.					
<b>FY 2013 Base Plans:</b> Continue second-generation plug-and-play ground testbed to fully test and demonstrate end-to-end flight ready spacecraft plug-and-play software and hardware.					
<b>FY 2013 OCO Plans:</b> N/A					
	3.487	2.594	1.991	-	1.991
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop modeling, simulation, and analysis tools for space-based surveillance systems, space capability protection technologies, access/mobility technologies, and flight experiments.					
<b>FY 2011 Accomplishments:</b> Developed graphic interfaces for simulation and analysis tools. Transitioned validated tools for use in customer flight programs. Applied lessons learned from analytical support, flight program participation, and external space organizations into refined modeling, simulation, and analysis tools that reduce cost and risk of flight programs and better model schedule limitations.					
<b>FY 2012 Plans:</b>					
	4.911	4.572	2.781	-	2.781

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>		<b>PROJECT</b> 632181: <i>Spacecraft Payloads</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Complete integration of autonomous flight software technologies with command, control, guidance, and navigation technologies. Apply additional physics-to-engineering-to-engagement level models for systems engineering, technology trades, mission planning and operations, and utility analysis to satellite experiments in space superiority mission areas.					
<b>FY 2013 Base Plans:</b> Validate the guidance, navigation, and control aspects of the autonomous flight software using the Mission Simulator flight software. Continue to provide engineering to engagement level models for systems engineering and trades, mission planning, and utility analysis to flight experiments and research areas.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
<b>Description:</b> Develop space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well as "cold body" targets.					
<b>FY 2011 Accomplishments:</b> Refined full focal plane array for exquisite imaging for space applications. Refined higher operating temperature sensor development and large format infrared sensor development.					
<b>FY 2012 Plans:</b> Develop full focal plane array for exquisite imaging for adaptive, comprehensive space situational awareness (SSA). Initiate higher operating temperature, large format medium wavelength infrared sensor development for wide area, global access detection and tracking.					
<b>FY 2013 Base Plans:</b> Continue large focal plane array development for exquisite imaging for adaptive, comprehensive SSA. Continue development of higher operating temperature, large format medium wavelength infrared sensors for wide area, global access detection and tracking.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>					
	4.138	4.359	3.891	-	3.891
	18.573	18.799	15.710	-	15.710

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 632181: <i>Spacecraft Payloads</i>
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				PE 0603401F: <i>Advanced Spacecraft Technology</i>				633834: <i>Integrated Space Technology Demonstrations</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633834: <i>Integrated Space Technology Demonstrations</i>	36.556	35.143	13.828	-	13.828	13.933	22.653	24.206	25.297	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other U.S. Government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in a relevant environment.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop satellite technologies for integrated, robust, flexible, satellite demonstrations building on previous work and leveraging investments by other organizations.

**FY 2011 Accomplishments:**

Completed integration of experimental satellite for geosynchronous orbit.

**FY 2012 Plans:**

Complete integration/test and space environmental testing in preparation for launch of experimental satellite for geosynchronous orbit. Complete ground system software for use in space operations. Begin design of next geosynchronous space flight demonstration.

**FY 2013 Base Plans:**

Complete satellite integration to the launch vehicle. Complete satellite flight software and orbit analyst tools for commanding satellite. Continue design of next geosynchronous space flight demonstration.

**FY 2013 OCO Plans:**

N/A

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	36.556	35.143	13.828	-	13.828
<b>Accomplishments/Planned Programs Subtotals</b>	36.556	35.143	13.828	-	13.828

**C. Other Program Funding Summary (\$ in Millions)**

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 633834: <i>Integrated Space Technology Demonstrations</i>

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>				<b>PROJECT</b> 634400: <i>Space Systems Protection</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
634400: <i>Space Systems Protection</i>	4.464	4.475	5.047	-	5.047	6.469	7.217	7.416	7.587	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates tools, instruments, and mitigation techniques required to assure operation of U.S. space assets in potentially hostile warfighting environments. The project performs assessments of critical components and subsystems, and evaluates susceptibility and vulnerability to radio frequency (RF) and laser threats. This project also develops technologies that mitigate identified vulnerabilities. Technologies are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Multi-threat assessment tools to assess space-based electro-optical, communication, and other responses to various candidate RF and laser countermeasures.</p> <p><b>FY 2011 Accomplishments:</b> Conducted extensive engineering analysis and down selected final systems. Performed subsystem testing of RF and laser countermeasures.</p> <p><b>FY 2012 Plans:</b> Conduct algorithm development and performance simulation to synthesize sensor input from multiple sources, on-board and off-board, to provide situational awareness.</p> <p><b>FY 2013 Base Plans:</b> Continue algorithm development and performance simulation to synthesize sensor input from multiple sources, on-board and off-board, to provide situational awareness.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	2.183	2.406	2.898	-	2.898
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites.</p> <p><b>FY 2011 Accomplishments:</b></p>	0.954	0.830	1.715	-	1.715

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>		<b>PROJECT</b> 634400: <i>Space Systems Protection</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
Developed performance goals using engineering models. Began design of future flight demonstration unit for passive satellite countermeasures.					
<b>FY 2012 Plans:</b> Identify local area sensors for indication and warnings concepts for engineering unit development. Begin process to identify future flight opportunity.					
<b>FY 2013 Base Plans:</b> Initiate local area sensor for indication and warnings engineering unit development. Continue to work process to identify future flight opportunity.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop active satellite local space awareness technologies and exploitation tools for satellite systems.					
<b>FY 2011 Accomplishments:</b> Developed performance goals using engineering models. Began design of flight demonstration unit for potential SSA applications.					
<b>FY 2012 Plans:</b> Design on-orbit threat detection, assessment, and response software systems. Focus technology development effort on on-orbit intelligent control of surveillance payloads. Explore technology for miniaturization of sensor concepts and improved dynamic sensitivity of sensor components.					
<b>FY 2013 Base Plans:</b> Demonstrate a hardware-in-the-loop responsive action to a selected postulated directed energy threat to a hypothetical friendly satellite. This includes the capability to detect threats on-board and provide autonomous potential courses of action to mitigate the postulated threat.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4.					
	0.880	0.942	0.145	-	0.145
	0.447	0.297	0.289	-	0.289

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 634400: <i>Space Systems Protection</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Develop RF characterization methods and performance analysis technology.</p> <p><b>FY 2011 Accomplishments:</b> Identified technology options that provide passive or active detection of satellites in the RF spectrum. Developed and completed engineering designs for systems used to support active space superiority technologies. Demonstrated subsystems through laboratory testing.</p> <p><b>FY 2012 Plans:</b> Evaluate sensing techniques for potential active and/or passive threat detection and tracking capabilities. Develop requirements and concepts to reduce vulnerabilities to next generation U.S. satellites.</p> <p><b>FY 2013 Base Plans:</b> Develop engineering model sensor sub-systems for active and/or passive threat detection and tracking capabilities. Initiate technology risk reduction for U.S. satellite vulnerability mitigation.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	4.464	4.475	5.047	-	5.047

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 634950: <i>Space Demonstration</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
634950: <i>Space Demonstration</i>	-	-	16.000	-	16.000	15.000	11.500	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project will provide mission design and development, payload integration, launch support, operations planning, and one-year of on-orbit operations for a Science and Technology space-launch mission. The project will provide a launch opportunity in support of the multi-agency “new entrant” certification strategy and the USAF Launch Services New Entrant Certification Guide.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Provide mission design and development, payload integration, launch support, operations planning, and one-year of on-orbit operations for a Science and Technology space-launch mission while supporting the multi-agency “new entrant” certification strategy.

**FY 2011 Accomplishments:**

N/A

**FY 2012 Plans:**

N/A

**FY 2013 Base Plans:**

Provide mission definition, design, development, and operations planning. Select and/or refine satellite and payload manifest. Initiate planning and integration of satellites and payloads onto launch vehicle.

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	-	-	16.000	-	16.000
<b>Accomplishments/Planned Programs Subtotals</b>	-	-	16.000	-	16.000

**C. Other Program Funding Summary (\$ in Millions)**

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• 0: <i>N/A</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 634950: <i>Space Demonstration</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				PE 0603401F: <i>Advanced Spacecraft Technology</i>				635021: <i>Space Systems Survivability</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635021: <i>Space Systems Survivability</i>	3.610	3.249	2.907	-	2.907	3.097	3.526	3.552	3.634	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates technologies to improve space system survivability and reliability of current and future Department of Defense space systems that must continue operation despite natural space hazards. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop technologies to provide improved space radiation and ionospheric hazard specification and forecasting.</p> <p><b>FY 2011 Accomplishments:</b> Completed initial version of new standard model of radiation belts. Began space test of miniaturized space weather sensors. Completed design and began construction of second-generation heliospheric imager as joint agency initiative.</p> <p><b>FY 2012 Plans:</b> Develop advanced standard model of radiation belts, using data from recently launched space environment instruments. Complete trade studies to narrow alternatives for a second-generation heliospheric imager for detecting and tracking solar coronal mass ejections (CMEs) which threaten space systems and degrade communications. Complete development of a more precise CME propagation model to enhance space weather forecasting tools.</p> <p><b>FY 2013 Base Plans:</b> Improve software tools to model surface and deep charging, radiation dose rate to spacecraft in real-time for evaluation of spacecraft anomalies. Continue development of an engineering model of an improved instrument to measure high-energy electrons and protons that contribute to radiation dose and spacecraft charging. Continue advanced development of concepts and technology for an operational capability in heliospheric imaging.</p> <p><b>FY 2013 OCO Plans:</b></p>	3.610	3.249	2.907	-	2.907



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 635021: <i>Space Systems Survivability</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	3.610	3.249	2.907	-	2.907

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 635083: <i>Ballistic Missiles Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635083: <i>Ballistic Missiles Technology</i>	5.053	5.216	5.081	-	5.081	5.377	6.214	6.260	6.404	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops, integrates, and demonstrates advanced technologies for sustainment and modernization of strategic ballistic missiles. The project focuses on developing robust, low maintenance inertial navigation instruments to sustain current ballistic missile systems, as well as provide new, small, low-powered, high-precision instrumentation for next generation missile systems.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop, integrate, and demonstrate advanced navigation instrumentation applied to emerging vehicle designs and other technologies that sustain current strategic missile systems.</p> <p><b>FY 2011 Accomplishments:</b> Developed, built, and tested advanced navigation instrument engineering model. Reduced advanced guidance risk through ground testing, sled testing, and flight test planning. Initiated build and test of flight capable advanced guidance system demonstration units integrated with strategic vehicle designs and interfaces.</p> <p><b>FY 2012 Plans:</b> Start follow-on effort to address next generation guidance and navigation technologies for future systems. Develop technologies that facilitate planned Analysis of Alternatives on next generation strategic weapons. Complete build and test Advanced Inertial Measurement Unit (AIMU) engineering model for enhanced ground testing and preparation for flight test. Focus integration studies of advanced technologies into strategic systems to reduce robustness, accuracy, and flexibility.</p> <p><b>FY 2013 Base Plans:</b> Improve AIMU design based on engineering model testing. Begin engineering model build of AIMU for possible flight testing. Begin additional hardening of AIMU design. Begin development of technologies for next generation strategic weapons requirements.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	2.528	5.216	5.081	-	5.081
<p><b>Title:</b> Major Thrust 2.</p>	2.525	-	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 635083: <i>Ballistic Missiles Technology</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Develop, integrate, and demonstrate navigation technologies with new vehicle designs to provide robust, flexible, lower cost solutions for sustaining current strategic missile systems.</p> <p><b>FY 2011 Accomplishments:</b> Completed qualification testing of designs against validated system level interfaces. Completed build and continued test and evaluation of advanced navigation instrumentation and range safety devices with new vehicle design interfaces. Integrated advanced guidance technologies with common vehicle designs and interfaces focused on lower cost solutions with increased accuracy, flexibility, and robustness.</p> <p><b>FY 2012 Plans:</b> This thrust has merged with the previous thrust.</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	5.053	5.216	5.081	-	5.081

<b>C. Other Program Funding Summary (\$ in Millions)</b>												
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 63682J: <i>Spacecraft Vehicles</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
63682J: <i>Spacecraft Vehicles</i>	6.847	7.127	5.984	-	5.984	4.515	3.662	3.880	3.959	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates compact, low-cost, spacecraft power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. This project also develops composites for spacecraft structures and technologies for spacecraft control and mechanisms.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop power generation space technologies such as multi-junction solar cells, thin-film solar cells, lightweight solar cell arrays, and radiation resistant solar cell modules.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated module technology traceable to greater than 300 watts/kilograms arrays.</p> <p><b>FY 2012 Plans:</b> Extend inverted metamorphic (IMM)-based solar cell development toward 35-37% efficiency. Conduct maturity development of quantum dot-enhanced IMM solar cells.</p> <p><b>FY 2013 Base Plans:</b> Complete development of efficient 34% IMM solar cell. Continue development of 35-37% IMM and quantum-dot enhanced IMM solar cells. Continue maturation of IMM solar cell interconnection and module technologies.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	1.857	1.456	2.188	-	2.188
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop technologies for long-life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications.</p> <p><b>FY 2011 Accomplishments:</b> Supported missile launch detection thermal and cryogenic SSA missions. Developed a non-moving parts compressor using proton biased membrane technology. Designed a low vibration conductance, cross gimbal</p>	0.663	1.637	0.891	-	0.891

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>		<b>PROJECT</b> 63682J: <i>Spacecraft Vehicles</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
35K cooling loop interface to support space tracking missions. Furthered the technology development of satellite cryogenic interface requirements and improved technologies to support space tracking applications.					
<b>FY 2012 Plans:</b> Work to reduce size, weight, and power requirements, ease integration, and increase reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for other modular systems. Evaluate passive versus active cooling, based on heat loads, power requirements, size, and payload thermal modeling. Provide correlated computer modeling results to industry to improve overall cryocooler design.					
<b>FY 2013 Base Plans:</b> Continue to reduce size, weight, and power requirements, ease integration, and increase reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry to significantly improve overall cryocooler design. Continue to provide correlated computer modeling results.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 3.					
<b>Description:</b> Develop composites for spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas.					
<b>FY 2011 Accomplishments:</b> Demonstrated novel deployable structural architectures. Demonstrated novel optical structures in relevant sub-system environment. Developed rapid fabrication processes to build tailored spacecraft panels in days, rather than weeks, and demonstrated and tested rapidly fabricated engineering model panels.					
<b>FY 2012 Plans:</b> Complete development of thermal management testbed for space structures. Initiate development of system-level deployable architectures for advanced optical systems and low-cost RF reflectors.					
<b>FY 2013 Base Plans:</b> Develop capability for providing structural dynamics data on large, deployable apertures for space systems. Develop technologies and processes for rapid calibration of payloads for space applications.					
<b>FY 2013 OCO Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	2.085	1.405	1.338	-	1.338

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>	<b>PROJECT</b> 63682J: <i>Spacecraft Vehicles</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>Title:</b> Major Thrust 4.	2.242	2.629	1.567	-	1.567
<b>Description:</b> Develop technologies for spacecraft controls and mechanisms for on-orbit applications.					
<b>FY 2011 Accomplishments:</b> Developed advanced guidance, navigation, and control hardware such as control moment gyroscopes and reaction wheels for rapid integration and test. Increased performance of hardware systems while maintaining rapid integration capability. Began development of hardware testbed for verifying performance of guidance, navigation, and control hardware systems.					
<b>FY 2012 Plans:</b> Transition high accuracy star tracker flight unit for use in customer flight program. Refine SSA camera tracking software in preparation for flight test. Design an autonomous mission manager for flight autonomy and on-orbit planning systems. Implement flight-like processors with hardware-in-the-loop to increase technical maturity.					
<b>FY 2013 Base Plans:</b> Demonstrate and transition SSA camera tracking software.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	6.847	7.127	5.984	-	5.984

<b>C. Other Program Funding Summary (\$ in Millions)</b>										
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603444F: <i>MAUI SPACE SURVEILLANCE SYSTEM</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	14.802	13.555	29.256	-	29.256	26.299	15.774	12.500	10.014	Continuing	Continuing
634868: <i>Maui Space Surveillance System</i>	14.802	13.555	29.256	-	29.256	26.299	15.774	12.500	10.014	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program funds ground-based optical space situational awareness (SSA) technology development and demonstration at the Maui Space Surveillance System (MSSS) in Hawaii, as well as the operation and upgrade of the facility. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	5.899	13.555	13.927	-	13.927
Current President's Budget	14.802	13.555	29.256	-	29.256
Total Adjustments	8.903	-	15.329	-	15.329
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.423	-			
• SBIR/STTR Transfer	-0.050	-			
• Other Adjustments	7.530	-	15.329	-	15.329

**Change Summary Explanation**

FY11: Other Adjustments include -0.070 Congressional General Reductions and 7.600 Technical Adjustment for realignment of Ground Imaging Research and Technology from PE 0602605F.

**C. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1/Congressional Add	14.802	13.555	19.944	-	19.944
<b>Description:</b> Operate and upgrade MSSS to support development, demonstration, and integration of ground-based optical SSA technologies.					

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603444F: <i>MAUI SPACE SURVEILLANCE SYSTEM</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
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<p><b><i>FY 2011 Accomplishments:</i></b>                      Began refurbishment and upgrade of MSSS to accommodate SSA research and technology development and to maintain requirements for safety and security in accordance with Air Force regulations. Repaired inoperable motor on 3.5 meter telescope. Operated MSSS facility for development and demonstration of ground-based optical SSA technologies such as characterization and identification of space objects.</p> <p><b><i>FY 2012 Plans:</i></b>                      Refurbish and upgrade MSSS to accommodate SSA research and technology development and to maintain requirements for safety and security in accordance with Air Force regulations. Operate MSSS facility for development and demonstration of ground-based optical SSA technologies such as characterization and identification of space objects.</p> <p><b><i>FY 2013 Base Plans:</i></b>                      Maintain MSSS facility and experimental equipment in a mission-ready state. Perform recurring upgrades and refurbishment to keep facilities and equipment in good working order. Modernize the control system to allow MSSS to perform efficiently and reliably. Operate MSSS facility for development and demonstration of ground-based optical SSA technologies such as characterization and identification of space objects.</p> <p><b><i>FY 2013 OCO Plans:</i></b>                      N/A</p>					
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<p><b><i>Title:</i></b> Major Thrust 2</p> <p><b><i>Description:</i></b> Develop and demonstrate a dual-use integrated sensor that can be used for identification of geosynchronous objects as well as other long-range applications.</p> <p><b><i>FY 2011 Accomplishments:</i></b>                      N/A</p> <p><b><i>FY 2012 Plans:</i></b>                      N/A</p> <p><b><i>FY 2013 Base Plans:</i></b>                      Begin development of a dual-use sensor for identification of objects in geosynchronous orbit.</p> <p><b><i>FY 2013 OCO Plans:</i></b></p>	-	-	9.312	-	9.312
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603444F: <i>MAUI SPACE SURVEILLANCE SYSTEM</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	14.802	13.555	29.256	-	29.256

<b>D. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**E. Acquisition Strategy**  
N/A

**F. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	23.445	25.283	21.523	-	21.523	17.088	18.406	16.758	16.007	Continuing	Continuing
635323: <i>Directed Energy Bioeffects Parameters</i>	2.332	2.286	1.040	-	1.040	0.837	1.153	1.000	0.971	Continuing	Continuing
635324: <i>Human Dynamics and Terrain Demonstration</i>	5.981	6.117	9.988	-	9.988	8.640	9.339	9.192	8.710	Continuing	Continuing
635325: <i>Mission Effective Performance</i>	4.038	5.149	3.925	-	3.925	2.336	2.685	1.994	2.006	Continuing	Continuing
635326: <i>Performance Enhancement Demonstration</i>	4.103	4.147	-	-	-	-	-	-	-	Continuing	Continuing
635327: <i>Warfighter Interfaces</i>	6.991	7.584	6.570	-	6.570	5.275	5.229	4.572	4.320	Continuing	Continuing

**Note**

In FY 2013, Project 635326, Performance Enhancement Demonstration, moves to Project 635324, Human Dynamics and Terrain Demonstration, to better align efforts

**A. Mission Description and Budget Item Justification**

This program develops and demonstrates technologies to enhance human performance and effectiveness in the aerospace force. State-of-the-science advances are made in warfighter training, warfighter system interfaces, directed energy bioeffects, deployment and sustainment of warfighters in extreme environments, and understanding and shaping adversarial behavior. The Mission Effective Performance project develops, demonstrates, and transitions advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. The Warfighter Interfaces project develops, demonstrates, and transitions technologies to revolutionize the way human operators synergistically use Air Force systems, including autonomous machines and adaptive teams of humans and machines. The Directed Energy Bioeffects Parameters project develops, demonstrates, and transitions technologies to predict, evaluate, and mitigate the effects of directed energy on personnel and mission performance, and exploits the offensive capabilities of directed energy systems. The Performance Enhancement Demonstration project develops, demonstrates, and transitions technologies to increase survivability and performance of personnel during military operations. The Human Dynamics and Terrain Demonstration project develops, demonstrates, and transitions human-centric technologies to address processing, exploitation, and dissemination of intelligence, surveillance, and reconnaissance (ISR) capability needs. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i>	PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>
BA 3: <i>Advanced Technology Development (ATD)</i>	

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	24.814	25.319	26.218	-	26.218
Current President's Budget	23.445	25.283	21.523	-	21.523
Total Adjustments	-1.369	-0.036	-4.695	-	-4.695
• Congressional General Reductions	-	-0.036			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.744	-			
• SBIR/STTR Transfer	-0.481	-			
• Other Adjustments	-0.144	-	-4.695	-	-4.695

**Change Summary Explanation**

FY11: Other Adjustments include -0.144 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

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<b>APPROPRIATION/BUDGET ACTIVITY</b>			<b>R-1 ITEM NOMENCLATURE</b>					<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>			PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>					635323: <i>Directed Energy Bioeffects Parameters</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635323: <i>Directed Energy Bioeffects Parameters</i>	2.332	2.286	1.040	-	1.040	0.837	1.153	1.000	0.971	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops, demonstrates, and transitions technologies to predict, evaluate, and mitigate the effects of directed energy on personnel and mission performance, and exploits the offensive capabilities of directed energy systems. This project also develops the human-components of the guidelines for testing, deployment, and protection from high power microwave and high energy laser systems and uses this information to enhance the effectiveness of these weapon systems in air, space, and cyber operations. The optical radiation bioeffects research develops and demonstrates technologies that counter optical threats, while exploiting optical systems for non-lethal applications. Radio frequency (RF) radiation bioeffects research develops, demonstrates, and transitions technologies to the warfighters. Biobehavioral systems efforts focus on the design and characterization of scalable non-lethal directed energy and novel effects weapons, including quantification of physiological and psychological effectiveness and risks associated with these weapons.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Develop and demonstrate optical protective technologies for aircrew and ground personnel to provide protection against directed energy threats. Develop modeling capabilities to assess collateral hazards from high power directed energy laser systems.

**FY 2011 Accomplishments:**

Incorporated validated human systems integration tools and techniques into vulnerability models. Continued monitoring optical radiation skin protection material technologies and RF radiation personnel protection technologies. Initiated research into advanced modeling and simulation of the bioeffects of high energy directed energy weapon systems. Continued research into advanced modeling and simulation software to predict target and collateral effects of high energy directed energy systems.

**FY 2012 Plans:**

Test end-to-end laser eye protection (LEP) design capability by merging frame and format design capability with a visual performance metrics and modeling capability to create a single, integrated package allowing complete human systems integration of LEP. Validate microwave modeling and simulation tool. Develop software to incorporate RF energy-induced human effects from collateral hazard predictions into war-gaming scenarios.

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
0.796	0.819	0.820	-	0.820

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**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p>Increase computational speed of collateral hazard predictions for near-real-time modules for weapon system fire control and mission planning applications.</p> <p><b>FY 2013 Base Plans:</b> Integrate and test physics-based modeling techniques for advanced laser eye protection in next generation cockpit scenarios for human systems integration and protection. Integrate laser bioeffects models and collateral effects algorithms into high-fidelity predictions of High Energy Laser weapons effects to enable safe testing of weapons effects and demonstrator concepts. Benchmark collateral hazard prediction algorithms for lasers.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop and demonstrate technologies to assess RF bioeffects and collateral hazards from high power RF directed energy systems.</p> <p><b>FY 2011 Accomplishments:</b> Performed field and laboratory experiments to verify and validate collateral hazard assessment software models on high energy laser systems and evaluate next generation of directed energy hazard assessment tools. Initiated software development to incorporate directed energy human effects from collateral hazard predictions into war-gaming scenarios. Increased computational speed of collateral hazard predictions for near- real-time modules for weapon system fire control and mission planning applications.</p> <p><b>FY 2012 Plans:</b> Continue testing and validation of high energy laser collateral effects real-time predictive models for directed energy weapon systems. Continue integration of directed energy hazard assessment tools in war-gaming scenarios. Test and validate near-real-time modules for weapon system fire control and mission planning applications.</p> <p><b>FY 2013 Base Plans:</b> Demonstrate validated microwave modeling and simulation tools to non-lethal RF weapon wargames for realistic human effects.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	1.536	1.467	0.220	-	0.220
<b>Accomplishments/Planned Programs Subtotals</b>	2.332	2.286	1.040	-	1.040

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>			<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u>	
			<u>Base</u>	<u>OCO</u>	<u>Total</u>					<u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>			<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>				
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>			PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>				635324: <i>Human Dynamics and Terrain Demonstration</i>				
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635324: <i>Human Dynamics and Terrain Demonstration</i>	5.981	6.117	9.988	-	9.988	8.640	9.339	9.192	8.710	Continuing	Continuing

**Note**  
Note: In FY 2013, Major Thrust 2 from Project 635326 moves into this project to better align efforts.

**A. Mission Description and Budget Item Justification**

This project develops, demonstrates, and transitions technologies to identify human threats within the air, space, and cyber domains. These technologies will enhance Air Force capabilities in intelligence, surveillance, and reconnaissance (ISR), layered sensing, autonomous and adaptive decision making systems, decision aids for computer network attack/defense/support, ISR force development and training, anticipatory command, control, and intelligence (C2I), measures of enhanced psychological operations, cross-cultural communication, and human-centric exploitation of measurement and signatures intelligence.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop, mature, and demonstrate technology to provide mission-essential capabilities for Air Force cyber operator performance enhancement and situational awareness.</p> <p><b>FY 2011 Accomplishments:</b> Developed technologies to increase cyber operator situational awareness capabilities. Evaluated suitability of technologies to transition cyber operator tools that integrate advanced influence operations technologies designed to anticipate and influence an adversary's behavior. Identified, integrated, demonstrated, and evaluated readiness for transition of technologies that increase human performance within cyber domain operations.</p> <p><b>FY 2012 Plans:</b> Continue cyber situational awareness integration technologies and develop technologies to enhance human performance in the cyber performance area.</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p>Note: This effort ends in FY 2012 due to higher Air Force priorities.</p> <p><b>FY 2013 OCO Plans:</b></p>	2.214	0.253	-	-	-



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>		<b>PROJECT</b> 635324: <i>Human Dynamics and Terrain Demonstration</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Develop/demonstrate human-centered design processes and operational tools that optimize ISR information flows in a distributed, multi-source mission planning environment. Develop/demonstrate anticipatory C2I decision-aiding technologies to rapidly assess battlefield behaviors, and select/prioritize courses of action. Develop/demonstrate anticipatory C2I decision-aiding technologies to rapidly assess battlefield situation, predict likely adversary behaviors, and select/prioritize courses of action.					
<b>FY 2011 Accomplishments:</b> Developed and demonstrated advanced ISR analyst productivity tools. Demonstrated, validated, and transitioned human-centric decision-aids, tools, and process improvements in integrated, computer-based ISR system tools and related techniques supporting ISR weapon systems with an emphasis on anticipatory approaches to enhance C2I. Developed, matured, assessed, and transitioned tools designed to increase ISR productivity by focusing on the interactions between humans and their automated planning and assessment tools. Evaluated the suitability, maturity, and readiness of demonstrated decision-aiding technologies for transition to component users. Incorporated final improvements into end-products.					
<b>FY 2012 Plans:</b> Deliver software prototype of unified analytical tool kit and work environment to support increased analyst speed and more robust, inclusive decision-making with lower cognitive overhead. Deliver prototype human-inspired cueing system to speed image analysis. Develop and test new methods to support visualization and manipulation of large, abstract data sets through combining recent advanced in neuroscience and neuroimaging techniques with neural-based feature extraction and data filtering. Build in-house prototype to rapidly and effectively detect and correlate relationships with patterns of life and anomalous threat detection and identification.					
<b>FY 2013 Base Plans:</b> Develop an analyst testbed concept for evaluating effectiveness of analyst tool integration in the processing, exploitation, and dissemination process. Develop work aids for intel analysts and tools for collaborative syntheses and social cognitive analysis.					
<b>FY 2013 OCO Plans:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	1.442	4.287	3.144	-	3.144

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>		<b>PROJECT</b> 635324: <i>Human Dynamics and Terrain Demonstration</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
N/A					
<b>Title:</b> Major Thrust 3					
<b>Description:</b> Develop/demonstrate technology to optimize human operator performance, adversarial modeling techniques, and automated speech translation tools to aid Air Force information/influence operations.					
<b>FY 2011 Accomplishments:</b> Demonstrated and determined the suitability, maturity, and readiness of next-generation information operations and cyber influence capabilities which yield non-kinetic warfighting options. Demonstrated and assessed the effectiveness of advanced adversarial cultural modeling techniques used to gauge adversarial threats and behavior signatures. Developed, demonstrated, and assessed the suitability of technology to transition advanced speech-to-speech translation tools that support automated, cross-cultural communications. Validated and improved models used to demonstrate measures of effectiveness for selected Air Force influence operations capabilities.					
<b>FY 2012 Plans:</b> Develop advanced techniques to rapidly develop and easily maintain speech-to-speech translation systems in multiple languages and application domains with limited data availability.					
<b>FY 2013 Base Plans:</b> Continue research and development on tools, algorithms, and techniques for development of domain specific automatic speech recognition (ASR), machine translation (MT), and natural language processing (NLP) components in new languages and domains, especially those characterized by minimal data availability.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 4					
<b>Description:</b> Apply human threat signatures to inform sensor development to develop research to enhance threat detection training for intelligence analysts, reconnaissance patrol, and force protection security operators.					
Note: In FY 2013, this Major Thrust moves from Project 635326 to better align efforts.					
<b>FY 2011 Accomplishments:</b>					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	2.325	1.577	2.500	-	2.500
	-	-	4.344	-	4.344

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635324: <i>Human Dynamics and Terrain Demonstration</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>FY 2012 Plans:</b> N/A					
<b>FY 2013 Base Plans:</b> Develop human threat recognition capabilities by creating libraries of human signatures to include simple and complex motions and biofidelic avatars with variable dimensions in gender, age, size, and shape. Demonstrate initial libraries in joint virtual training software for human threat recognition and feasibility for integration into future on-board sensor systems.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	5.981	6.117	9.988	-	9.988

<b>C. Other Program Funding Summary (\$ in Millions)</b>												
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>				635325: <i>Mission Effective Performance</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635325: <i>Mission Effective Performance</i>	4.038	5.149	3.925	-	3.925	2.336	2.685	1.994	2.006	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops, demonstrates, and transitions advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. This project also develops advanced methods and technologies to enable interactive live, virtual, and constructive (LVC) environments for performance-aiding methods and technologies. Activities include development of computer-generated entities to support training, simulation, and mission rehearsal; integrated high-fidelity weapon-systems training technologies for air, space, and cyber; tailored immersive simulation environments for Airmen at the tactical and operational levels; robust performance assessment and feedback tools; and maturation of game-based technologies for effective and efficient training. These methods and technologies facilitate the development of mission-essential competencies.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Advance aerospace/organizational behavior models for integrated warfighter training and rehearsal. Add realistic operations, command and control, force protection, and air base defense.</p> <p><b>FY 2011 Accomplishments:</b> Completed field deployment and evaluation of embedded performance measurement and reporting system for combat mission readiness. Developed preliminary functionality for a learning management system for distributed mission operations and LVC training, rehearsal, and exercise. Developed and evaluated an integrated environment for learning and assessment that includes live, virtual, and constructive air operations center planners, ground command and control, close air support aircraft, terminal attack and control personnel, and air combat assets. Completed development and field assessment of tailored training inside the ready aircrew program allocation of sorties and mission types for at least three mission areas and operational systems. Developed specifications for interface and data control approaches for managing learning in LVC contexts. Began development of a reconfigurable and deployable training environment for combat training and rehearsal.</p> <p><b>FY 2012 Plans:</b> Conduct initial evaluations of the reconfigurable and deployable training environment for Air Force applications. Complete evaluation for deployable training for Combatant Commander capability assessment across LVC contexts. Complete specification development for an integrated learning assessment and management system for Distributed Mission Operations (DMO) and LVC operations. Complete and demonstrate team communication</p>	1.572	1.962	3.925	-	3.925

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>		<b>PROJECT</b> 635325: <i>Mission Effective Performance</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>					
tracking and assessment methods in Air and Space Operation Center (AOC) and cyber operations training. Define data and interoperability standards for remotely piloted aircraft sensor and pilot training integration in LVC operations. Develop and demonstrate learning management tools. Demonstrate integration of performance metrics in the after action review tool kit.					
<b>FY 2013 Base Plans:</b> Demonstrate learning managed LVC for 5th generation air combat mission training. Develop joint criteria, models, and tools for environment certification applicable across LVC contexts. Demonstrate standardized process and integrated toolsets for correlated simulation database development.					
Note: Funding for this effort increases in FY 2013 to increase emphasis in this area.					
<b>FY 2013 OCO Plans:</b> N/A					
<b>Title:</b> Major Thrust 2					
<b>Description:</b> Develop/demonstrate high-fidelity DMO training/rehearsal capability for AOC operators and training technologies for future threat systems/capabilities.					
<b>FY 2011 Accomplishments:</b> Developed code, integrated, and tested the execution management capabilities for the simulation set. Developed, integrated, and tested the performance assessment capability within the simulation set. Developed scenario authoring tools and integrate with simulation components. Tested and integrated the entire strategy and plans division trainer and began integration with the AOC part task trainer. Developed vendor-specific real-time database examples from the database generation system's outputs. Began development of methodologies for real-time incorporation of data into DMO, homeland security, and C2ISR databases. Demonstrated a multi-ship/onboard networked LVC EW training concept. Conducted an integrated, on-board EW training demonstration with live aircraft and with a major test/training range.					
<b>FY 2012 Plans:</b> Begin definition of multi-level security rule sets for integrated LVC operations across fourth and fifth generation operational systems and different classification enclaves. Develop and demonstrate efficient multi-level rule set definition and accreditation tools for secure training and rehearsal within a single classification enclave. Complete development and demonstration of common competency-based training and assessment for cyber					
	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	2.466	3.187	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635325: <i>Mission Effective Performance</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

and LVC operations. Complete transition and field integration of embedded performance assessment system in optional mission training centers.

**FY 2013 Base Plans:**  
N/A

Note: This effort ends in FY 2012 due to higher Air Force priorities.

**FY 2013 OCO Plans:**  
N/A

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<b>Accomplishments/Planned Programs Subtotals</b>	4.038	5.149	3.925	-	3.925

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635326: <i>Performance Enhancement Demonstration</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635326: <i>Performance Enhancement Demonstration</i>	4.103	4.147	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: In FY 2013, this project moves to Project 635324 to better align efforts.

**A. Mission Description and Budget Item Justification**

This project develops, demonstrates, and transitions technologies to increase survivability and performance of personnel during military operations. Bioscience efforts develop advanced biotechnology, nanotechnology, and neuroscience solutions for the protection and enhanced effectiveness of battlefield airmen. Counterproliferation efforts develop biotechnology and bio-tagchants to advance the ability to detect, identify, monitor, and neutralize biological threat agents. The counterproliferation effort also demonstrates and transitions modeling and simulation techniques for operational assessment of pre- and post-bio-agent attack. Biobehavioral and biomechanics focus areas develop aircrew support technologies that enhance warfighter protection and improve performance during long-duration missions. The biomechanics focus area also develops technology to rapidly integrate multi-sensor data with automated dynamic human modeling to anticipate and identify human adversarial threats.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Demonstrate tailored bio-tagchant and identification/neutralization capabilities to enhance force protection and enable air operations commanders to maintain operations tempo.</p> <p><b>FY 2011 Accomplishments:</b> Validated selected bio-tagchant technologies in the laboratory. Continued to investigate suitable platforms to integrate bio-tagchant technologies.</p> <p><b>FY 2012 Plans:</b> Validate selected bio-tagchant technologies in a simulated operational environment. Identify an integration platform. Demonstrate taggant technology that performs stand off detection of biological agents in an operational environment to include line-of-sight and free-from-sight stand off detection of biological warfare agents and personnel who have been exposed to Weapons of Mass Destruction.</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b></p>	1.815	2.046	-	-	-

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635326: <i>Performance Enhancement Demonstration</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
N/A					
<b>Title:</b> Major Thrust 2  <b>Description:</b> Apply human threat signatures to inform sensor development to develop research to enhance threat detection training for intelligence analysts, reconnaissance patrol, and force protection security operators.  <b>FY 2011 Accomplishments:</b> Demonstrated a morphable 3D dynamic human model that adapts to different sensor input, predicts threat, and optimizes sensor combination and placement for human threat detection. Developed new human shape variation and visualization for threat awareness capability for the deployed airmen.  <b>FY 2012 Plans:</b> Develop training based on physical/physiological indicators of deceptive behavior. Initiate development of software training module for human threat indicators. Provide requirements for sensor resolution and optimized sensor placement for human threat indicator detection.  <b>FY 2013 Base Plans:</b> N/A  <b>FY 2013 OCO Plans:</b> N/A	2.288	2.101	-	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	4.103	4.147	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635327: <i>Warfighter Interfaces</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635327: <i>Warfighter Interfaces</i>	6.991	7.584	6.570	-	6.570	5.275	5.229	4.572	4.320	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops, demonstrates, and transitions technologies to revolutionize the way human operators optimize the capabilities of Air Force systems, including autonomous machines and adaptive teams of humans and machines. Improvements in the presentation of operational information to the community of users, from the system operator to the commander, must be developed in step with advancements in the acquisition, storage, and retrieval of information. This project provides the advances in understanding of human cognitive abilities, as well as the utilization of human interfaces, multi-sensory fusion, high-resolution image displays, and three-dimensional audio to customize communications and enhance shared understanding across a diverse user community in air, space, and cyber for maximum situational awareness.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1

**Description:** Develop immersion technologies and augmented vision, to facilitate team building and workflow in a distributed C2 environment and exploit telepresence in urban operations. Develop job performance aiding technologies that assess workload and performance to more effectively determine work re-allocation in a C2 distributed environment.

**FY 2011 Accomplishments:**

Developed flexible and modular proof-of-concept interface tools used for team formation, intense collaboration, sensemaking, distributed decision support, and workflow. These tools will be used by C2 collaborators under cyber fight-through conditions and when conducting cyber-supported mission assurance activities. Integrated and tested functionality of the modular distributed tools for demonstration in various C2 team decision making environments. Initiated technology demonstrations in representative users' cyber environments. Developed visual interface and incorporate advanced algorithms for planning military mobility operations. Demonstrated the ability to exploit automated planning to optimize the use of resources within Joint Deployment and Distribution Enterprise capacity constraints. Provided for real-time operator interaction within the capacity-based planner and begin to quantify the benefits of the human-automation interaction relative to current capabilities.

**FY 2012 Plans:**

Develop technology to assess the value of operator immersion and related virtual presence technology for improving human and mission performance, design novel warfighter visualizations, and develop intuitive control methods for exercising telepresence in the urban battlespace. Develop conceptual operator telepresence

FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
2.555	4.553	1.457	-	1.457

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635327: <i>Warfighter Interfaces</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>interfaces (remote and on-scene) for the larger context of supervisory control of the sensor networks and ISR services. Assess hardware and software technology options for developing team workload and performance detection capability and visualization requirements. Begin to develop and plan to integrate both on-human and off-human sensors. Work with command and control operational users from Control and Reporting Centers to identify characteristics of team membership and visualization requirements.</p> <p><b>FY 2013 Base Plans:</b> Develop neurophysiologic sensed technology for determining operator workload. Integrate neurophysiologic sensors with automated system adaptation methods, software, and tools. Identify visualization, tool composition, and user interface requirements to support cyber operations. Analyze human operator team composition and requisite skill sets based upon cyber tool set composition and information flow. Based upon human-computer interface requirements analyses, provide training recommendations for the transition of cyber offensive tools to the operational community.</p> <p>Note: Decrease in FY13 is due to higher Air Force priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Demonstrate ability to forecast acoustic profiles for any atmospheric/terrain condition. Demonstrate technologies to enhance the battlefield airman's situational awareness through wearable interfaces.</p> <p><b>FY 2011 Accomplishments:</b> Completed final evaluations of integrated components. Demonstrated the integrated system concept, including advanced audio, speech, and visual interfaces, improved human-centric software applications, wearable power management systems, and ergonomically improved cabling and carriage concepts. Conducted laboratory evaluations to assess effectiveness of integrated system and compare performance to original baseline. Conducted field evaluations of technology components and prepare for transition to operational capability.</p> <p><b>FY 2012 Plans:</b> Integrate a high fidelity acoustic simulation model into existing Air Force fielded software applications to demonstrate technology in the user's environment. Perform initial proof-of-concept verification and validation of the integrated acoustic model. Develop and test field data collection procedures to validate the acoustic</p>	1.463	0.971	1.823	-	1.823

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force				<b>DATE:</b> February 2012						
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>		<b>PROJECT</b> 635327: <i>Warfighter Interfaces</i>						
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>										
<p>predictions of sound propagation and source characterization. Collect soundscape data for a background noise database. Perform related research on human hearing and vigilance.</p> <p><b>FY 2013 Base Plans:</b> Develop three-dimensional acoustic models of manned and unmanned aircraft for incorporation into high-fidelity acoustic mission planning tools. Collect high-fidelity three-dimensional acoustic measurements of manned and unmanned aircraft. Determine aural detectability across a wide range of weather conditions, geography, and background sounds. Employ usability engineering methodologies to establish user requirements and use-case scenarios for the para-rescue jumper community. Prototype designs of wearable interface concepts.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>						<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<p><b>Title:</b> Major Thrust 3</p> <p><b>Description:</b> Develop and demonstrate an integrated human-centered interface to control multiple RPA that have various levels of autonomy and that optimize net-centric information flow.</p> <p><b>FY 2011 Accomplishments:</b> Completed the development of advanced multi-RPA control station technology for dynamic reconnaissance, surveillance, and time-critical target acquisition missions. Completed the integration of cooperative engagement algorithms and operator interface technologies for technology demonstration. Completed the demonstration and assessment of system performance and mission effectiveness enabled by the next-generation supervisory control station, using high-fidelity virtual simulation and flight test environments. Determined how many vehicles an RPA operator can effectively manage/supervise.</p> <p><b>FY 2012 Plans:</b> Analyze warfighter requirements for a future generation control station that will accommodate advanced and legacy RPAs. Develop and integrate operator interface controls, displays, and decision-aid technologies for effective situation assessment, decision-making, and action implementation to manage semi-autonomous, multi-mission RPAs and heterogeneous payloads. Test control station technology to determine baseline functionality and performance.</p> <p><b>FY 2013 Base Plans:</b> Validate warfighter requirements for the next generation operator control station that will accommodate advanced and legacy RPAs. Integrate and test operator interface controls, displays, and decision-aids to</p>						1.422	1.032	3.290	-	3.290

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635327: <i>Warfighter Interfaces</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>manage multi-mission RPAs and payloads. Conduct prototype evaluations of operator interface controls. Perform initial testing of technologies designed to assess the value of RPA operator immersion and telepresence for improving human and mission performance.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 4</p> <p><b>Description:</b> Develop cognitive-based analytic/design methods and computer software tools for C2 operations to synchronize personnel in distributed locations and obtain visually intuitive battlespace awareness.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated and evaluate a unifying C2 work-aiding framework supporting distributed cross-organizational teams and individuals, including integration of a representative set of existing tools. Examined results and refine work-centered analytic, design, and development methods and techniques as applied to teams.</p> <p><b>FY 2012 Plans:</b> N/A</p> <p>Note: This effort completed in FY 2011.</p> <p><b>FY 2013 Base Plans:</b> N/A</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	1.551	-	-	-	-
<p><b>Title:</b> Major Thrust 5</p> <p><b>Description:</b> Develop and demonstrate space visualization technologies that provide visually intuitive awareness of the battlespace, including trend portrayal useful for decision making.</p> <p><b>FY 2011 Accomplishments:</b> N/A</p> <p><b>FY 2012 Plans:</b></p>	-	1.028	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	<b>PROJECT</b> 635327: <i>Warfighter Interfaces</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Examine and analyze the workflow and information required to provide warfighters with an inherent awareness of the operational space situation. Exploit available cognitive task analyses of space operations and develop user requirements for visualization tools that simplify the process of portraying relevant data from large data sets. Develop and test laboratory prototypes of visualization tools developed from user-derived requirements.  <b>FY 2013 Base Plans:</b> N/A  Note: This effort ends in FY 2012 due to higher Air Force priorities.  <b>FY 2013 OCO Plans:</b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	6.991	7.584	6.570	-	6.570

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: <i>Conventional Weapons Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	14.764	45.542	36.352	-	36.352	33.996	46.589	50.568	51.559	Continuing	Continuing
63670A: <i>Conventional Weapons Development</i>	14.764	45.542	36.352	-	36.352	33.996	46.589	50.568	51.559	Continuing	Continuing

**Note**

In FY 2013, changes are due to higher AF priorities.

**A. Mission Description and Budget Item Justification**

This program develops, demonstrates, and integrates ordnance and advanced guidance technologies for air-launched conventional weapons. The program includes development of conventional ordnance technologies including warheads, fuzes, and explosives; and development of advanced guidance technologies including seekers, navigation and control, and guidance. Technologies to be developed, demonstrated, and integrated include blast, fragmentation, penetration, low-collateral damage warheads, variable depth/location fuzing, precise guidance, and high performance and insensitive explosives. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

**B. Program Change Summary (\$ in Millions)**

	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	15.755	54.042	26.852	-	26.852
Current President's Budget	14.764	45.542	36.352	-	36.352
Total Adjustments	-0.991	-8.500	9.500	-	9.500
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-8.500			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.473	-			
• SBIR/STTR Transfer	-0.438	-			
• Other Adjustments	-0.080	-	9.500	-	9.500

**Change Summary Explanation**

In FY11, Other Adjustments include: -0.080 Congressional General Reductions

Increase in FY13 is due to an increase in Air Force priority on munition concepts that increase the capacity and capability of fifth-generation aircraft.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: <i>Conventional Weapons Technology</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop and demonstrate ordnance technologies to improve conventional, air-delivered munitions. Specific technical areas of focus include fuzes, energetic materials, warheads, and integration.</p> <p><b>FY 2011 Accomplishments:</b> Developed technologies for a conventional ordnance package capable of penetrating high performance concrete at velocities up to 2,500 feet per second.</p> <p><b>FY 2012 Plans:</b> Continue developing technologies for a conventional ordnance package capable of penetrating high performance concrete at velocities up to 2,500 feet per second. Develop and demonstrate technologies and approaches that incorporate velocity augmentation capability for penetrating weapons. Develop an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment.</p> <p><b>FY 2013 Base Plans:</b> Continue developing technologies for a conventional ordnance package capable of penetrating high performance concrete at velocities up to 2,500 feet per second. Continue developing and demonstrating technologies and approaches that incorporate velocity augmentation capability for penetrating weapons. Continue developing an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	8.673	29.257	16.641	-	16.641
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop and demonstrate guidance technologies to improve the precision, controlled lethality, and flexibility of conventional, air-delivered munitions.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated advanced guidance technologies to enable small guided munitions to attack multiple moving targets.</p> <p><b>FY 2012 Plans:</b></p>	1.434	10.015	4.246	-	4.246



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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: <i>Conventional Weapons Technology</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Continue demonstration of dynamic path planning and target engagement technologies to enable close controlled strike munitions concepts. Develop technology for precision weapon navigation in Global Positioning System (GPS)-degraded environments.</p> <p><b>FY 2013 Base Plans:</b> Continue developing technology for precision weapon navigation in GPS-degraded environments. Develop technologies capable of guiding a high-speed strike weapon characterized by very high terminal speed and high end-game maneuverability.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<p><b>Title:</b> Major Thrust 3</p> <p><b>Description:</b> Demonstrate advanced conventional munition concepts. These innovative concepts integrate ordnance, guidance, and carriage and release technologies to demonstrate a warfighter capability.</p> <p><b>FY 2011 Accomplishments:</b> Developed missile technologies to defeat a broad range of small and highly agile air targets, as well as high value ground targets, such as enemy air defenses. Further developed a small, short-range precision-guided munition capable of attacking multiple moving targets.</p> <p><b>FY 2012 Plans:</b> Continue developing missile technologies to defeat a broad range of small and highly agile air targets, as well as high value ground targets, such as enemy air defenses. Begin demonstration of technologies that enable a munition to provide effects tailorable to the target and surrounding environment. Further refine employment concepts and system technologies for high-speed penetrating weapons with velocity augmentation. Begin development of a munition concept to incorporate technologies for carriage and terminal impact at high-speed. Continue demonstration of technologies that enable a small, short-range precision guided munition to attack multiple moving targets.</p> <p><b>FY 2013 Base Plans:</b> Continue developing missile technologies to defeat a broad range of small and highly agile air targets, as well as high value ground targets, such as enemy air defenses. Continue to refine employment concepts and system technologies for high-speed penetrating weapons with velocity augmentation. Continue development of a</p>	4.657	6.270	15.465	-	15.465

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: <i>Conventional Weapons Technology</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
munition concept to incorporate technologies for carriage and terminal impact at high-speed. Increase emphasis on munition concepts that increase the capacity and capability of fifth-generation aircraft.  <b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	14.764	45.542	36.352	-	36.352

**D. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**E. Acquisition Strategy**  
N/A

**F. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	16.104	48.666	19.004	-	19.004	19.950	31.056	31.181	31.730	Continuing	Continuing
633150: <i>Advanced Optics Technology</i>	-	20.000	-	-	-	-	-	-	-	Continuing	Continuing
633151: <i>Lasers and Imaging Development and Integration</i>	6.182	16.477	9.313	-	9.313	9.518	19.775	19.806	20.139	Continuing	Continuing
633152: <i>High Power Microwave Development and Integration</i>	9.922	12.189	9.691	-	9.691	10.432	11.281	11.375	11.591	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program provides for the development, integration, demonstration, and detailed assessment of directed energy weapon technologies including high energy laser, high power microwave (HPM), and other unconventional weapon generation and transmission technologies, which can support a wide range of Air Force applications. The program develops a corresponding susceptibility, vulnerability, and lethality data base for directed energy weapons. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

**B. Program Change Summary (\$ in Millions)**

	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	17.461	28.683	32.749	-	32.749
Current President's Budget	16.104	48.666	19.004	-	19.004
Total Adjustments	-1.357	19.983	-13.745	-	-13.745
• Congressional General Reductions	-	-0.017			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	20.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.798	-			
• SBIR/STTR Transfer	-0.470	-			
• Other Adjustments	-0.089	-	-13.745	-	-13.745

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 633150: *Advanced Optics Technology*  
Congressional Add: *Space Situational Awareness.*

FY 2011	FY 2012
-	20.000

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>
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**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

	FY 2011	FY 2012
Congressional Add Subtotals for Project: 633150	-	20.000
Congressional Add Totals for all Projects	-	20.000

**Change Summary Explanation**

FY11: Other Adjustments include -0.089 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>	<b>PROJECT</b> 633150: <i>Advanced Optics Technology</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633150: <i>Advanced Optics Technology</i>	-	20.000	-	-	-	-	-	-	-	Continuing	Continuing

**Note**

Note: Funding in this project is due to Congressional adds.

**A. Mission Description and Budget Item Justification**

This project develops advanced optical technologies for various strategic and tactical beam control applications.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012
<b>Congressional Add:</b> Space Situational Awareness.	-	20.000
<b>FY 2011 Accomplishments:</b> N/A		
<b>FY 2012 Plans:</b> Conduct Congressionally-directed effort.		
<b>Congressional Adds Subtotals</b>	-	20.000

**C. Other Program Funding Summary (\$ in Millions)**

Line Item	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>	<b>PROJECT</b> 633151: <i>Lasers and Imaging Development and Integration</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633151: <i>Lasers and Imaging Development and Integration</i>	6.182	16.477	9.313	-	9.313	9.518	19.775	19.806	20.139	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project provides for the development, integration, demonstration, and detailed assessment of high energy laser and beam control technologies needed for applications such as aircraft self-protection, force protection, force application, and precision engagement. Laser system concept assessments to include vulnerability assessments and target effect testing are performed.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop and demonstrate laser technologies for applications such as aircraft self-protection from threats not susceptible to traditional jamming techniques.</p> <p><b>FY 2011 Accomplishments:</b> Investigated integrated breadboard aircraft self-protection technologies compatible with mid-wave infrared detection and jamming capabilities. Validated aircraft self-protection fly-out model codes with effects/lethality data.</p> <p><b>FY 2012 Plans:</b> Develop an integrated breadboard to demonstrate focal plane array damage technologies for aircraft self-protection.</p> <p><b>FY 2013 Base Plans:</b> Investigate subsystem and system level capability concepts that integrate technologies for aircraft self-protection.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>	1.970	0.533	0.174	-	0.174
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Develop and demonstrate advanced beam control technologies and demonstrate beam control components integrated with high energy lasers.</p> <p><b>FY 2011 Accomplishments:</b></p>	4.212	15.944	9.139	-	9.139

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>	<b>PROJECT</b> 633151: <i>Lasers and Imaging Development and Integration</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
With Defense Advanced Research Projects Agency (DARPA), continued to mature technologies to integrate their high power solid state laser device with the appropriate beam control subsystems and began checkout and subsystem performance testing in preparation for the FY 2013/2014 ground demonstrations.					
<b><i>FY 2012 Plans:</i></b> With DARPA, integrate a high energy electric laser device with a beam control subsystem on the ground. Develop technologies and concepts for the integration of a high power electric laser and a beam control system on a large aircraft.					
<b><i>FY 2013 Base Plans:</i></b> With DARPA, demonstrate an integrated high energy electric laser device with a beam control subsystem on the ground. Plan for technologies and concepts for the integration of an electric laser and a beam control system on a large aircraft.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	6.182	16.477	9.313	-	9.313

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>	<b>PROJECT</b> 633152: <i>High Power Microwave Development and Integration</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
633152: <i>High Power Microwave Development and Integration</i>	9.922	12.189	9.691	-	9.691	10.432	11.281	11.375	11.591	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project develops and demonstrates high power microwave (HPM) and other unconventional weapon generation and transmission technologies that support a wide range of Air Force missions such as the potential disruption, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. It also develops a susceptibility, vulnerability, and lethality data base.

**B. Accomplishments/Planned Programs (\$ in Millions)**

**Title:** Major Thrust 1.

**Description:** Develop and evaluate HPM and other unconventional weapon technologies for various platforms, including aerial for applications such as counter-electronics. Develop and evaluate HPM technologies for non-lethal, anti-personnel weapon applications.

**FY 2011 Accomplishments:**

Completed the integration of narrowband HPM components into the Counter-electronics High Power Microwave Advanced Missile Project (CHAMP) aerial platform. Conducted additional ground testing of the CHAMP HPM system including effects testing and characterization of the performance. Conducted an inert flight test with the aerial platform to verify the guidance system accuracy, platform controllability for beam pointing, and timing for triggering of the HPM payload. Developed and evaluated technologies for Air Force non-lethal weapons applications. Began prime power hardware development for next generation transmitters. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and gleaned data relevant to airborne applications.

**FY 2012 Plans:**

Conduct two flight tests of the HPM payload for the CHAMP Joint Capability Technology Demonstration against a wide range of targets in multiple buildings. Evaluate the effectiveness of CHAMP against the various targets.

**FY 2013 Base Plans:**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
	9.922	12.189	9.691	-	9.691



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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>	<b>PROJECT</b> 633152: <i>High Power Microwave Development and Integration</i>
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**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Begin development of a multi-target, re-useable HPM counter-electronics munition demonstrator. Develop and evaluate technologies to reduce size, weight, and power consumption for compact systems in an integrated platform with anti-tamper and battle damage assessment capabilities.					
<b><i>FY 2013 OCO Plans:</i></b> N/A					
<b>Accomplishments/Planned Programs Subtotals</b>	9.922	12.189	9.691	-	9.691

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	46.564	40.103	37.045	-	37.045	36.353	41.444	38.884	41.233	Continuing	Continuing
635280: <i>Manufacturing Technologies</i>	44.618	39.119	37.045	-	37.045	36.353	41.444	38.884	41.233	Continuing	Continuing
635281: <i>Manufacturing Readiness</i>	1.946	0.984	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The Manufacturing Technology (ManTech) program executes technical programs to maintain and develop an affordable and reliable industrial base and manufacturing capability that will be responsive to warfighter needs. The program develops and improves manufacturing technologies and processes to enable cost reduction, improve component and system quality, and enhance industrial capability. Further, value stream modifications and manufacturing throughput improvements are effected to shorten cycle times of weapon systems during design, development, production and sustainment. ManTech objectives are conducted through industrial partnerships which enable the demonstration of manufacturing technologies for existing weapon system upgrades and/or for new warfighter systems. Efforts in the program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. Manufacturing Technologies is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates manufacturing technologies for existing upgrades and/or new system developments that have military utility and address warfighter needs.

**B. Program Change Summary (\$ in Millions)**

	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	39.701	40.103	40.534	-	40.534
Current President's Budget	46.564	40.103	37.045	-	37.045
Total Adjustments	6.863	-	-3.489	-	-3.489
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.022	-			
• SBIR/STTR Transfer	-0.872	-			
• Other Adjustments	7.757	-	-3.489	-	-3.489

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 635280: *Manufacturing Technologies*

Congressional Add: *Best Industrial Processes for Department of Defense Depots*

FY 2011	FY 2012
8.000	-

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>
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<u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u>	FY 2011	FY 2012
Congressional Add Subtotals for Project: 635280	8.000	-
Congressional Add Totals for all Projects	8.000	-

**Change Summary Explanation**

FY11: Other Adjustments include -0.243 Congressional General Reductions and 8.000 Congressional Adds

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>	<b>PROJECT</b> 635280: <i>Manufacturing Technologies</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635280: <i>Manufacturing Technologies</i>	44.618	39.119	37.045	-	37.045	36.353	41.444	38.884	41.233	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The Manufacturing Technology (ManTech) program executes technical programs to maintain and develop an affordable and reliable industrial base and manufacturing capability that will be responsive to warfighter needs. The projects include development and improvement of manufacturing technologies and processes; collaboration with government program offices, industry, and academia; investments in generic technologies that can be applied to different applications; cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. To this end, ManTech develops and demonstrates advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. Where mature processes are not available, laboratory-developed and demonstrated initial process capabilities are made available for transition into weapon system programs. ManTech objectives are conducted through partnerships with all industry levels, from large prime contractors to small material and parts vendors.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Title:</b> Major Thrust 1</p> <p><b>Description:</b> Develop and implement cost-effective maintenance, repair, and manufacturing technologies for sustainment of Air Force weapon systems.</p> <p><b>FY 2011 Accomplishments:</b> Continued efforts for cost-effective repair and manufacturing technologies enabling affordable sustainment of both conventional and low-observable aircraft, and turbine engine components. Continued assessments and manufacturing technology development to reduce logistics support costs, lead times for high value supply chain commodities, and cycle times for depot repair. Continued demonstration of productivity improvement efforts with selected high value programs. Conducted efforts supporting High Velocity Maintenance concept at Air Logistics Centers to reduce Programmed Depot Maintenance cycle times and cost.</p> <p><b>FY 2012 Plans:</b> Continue efforts for cost-effective development of conventional and low-observable repair and manufacturing technologies enabling affordable sustainment of aircraft and turbine engine components. Continue assessments and manufacturing technology development to reduce logistics support costs, lead times for high value supply chain commodities, and cycle times for depot repair. Continue efforts supporting High Velocity Maintenance concept at Air Logistics Centers to reduce Program Depot Maintenance cycle times and cost.</p>	14.647	16.309	12.798	-	12.798

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>	<b>PROJECT</b> 635280: <i>Manufacturing Technologies</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p>Pursue improvements in energy consumption required during manufacturing operations to reduce processing costs. Training responsibilities have been transitioned to Air University to be utilized for Manufacturing Readiness Assessment (MRA) and Manufacturing Readiness Level (MRL) support.</p> <p><b>FY 2013 Base Plans:</b> Continue efforts for cost effective development of conventional and low observable production and repair technologies enabling affordable sustainment of aircraft systems. Continue assessments and manufacturing technology development to reduce logistics support costs, lead times for high value supply chain commodities, and cycle times for depot repair. Provide subject matter expertise in support of Manufacturing Readiness Assessments (MRAs) on Advanced Technology Demonstrations (ATDs), selected high-visibility technology programs and selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule issues.</p> <p><b>FY 2013 OCO Plans:</b> N/A.</p>					
<p><b>Title:</b> Major Thrust 2</p> <p><b>Description:</b> Develop and transition pervasive affordability and producibility technologies for weapon systems and processes.</p> <p><b>FY 2011 Accomplishments:</b> Continued development and demonstration of rapid response and flexible manufacturing methods, commercial/military integration, quality processing, and supply stream improvements. Advanced development and demonstration of manufacturing capabilities for more affordable low-observable structures, advanced propulsion technologies, electronics manufacturing technologies for command and control; intelligence, surveillance, and reconnaissance (C2ISR); space; and advanced radar applications.</p> <p><b>FY 2012 Plans:</b> Continue development demonstration of rapid response and flexible manufacturing methods, commercial/military integration, quality processing, and supply stream improvements. Continue demonstration of manufacturing capabilities for more affordable low-observable structures, advanced propulsion technologies, electronics manufacturing technologies for C2ISR, space, and advanced radar applications.</p> <p><b>FY 2013 Base Plans:</b></p>	21.971	22.810	24.247	-	24.247

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>	<b>PROJECT</b> 635280: <i>Manufacturing Technologies</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Continue development demonstration of rapid response and flexible manufacturing methods, commercial/military integration, quality processing and supply stream improvements. Continue demonstration of manufacturing capabilities for more affordable low observable structures, advanced propulsion technologies, electronics and optics manufacturing technologies for C2ISR, space solar cells, and advanced radar applications.  <i>FY 2013 OCO Plans:</i> N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	36.618	39.119	37.045	-	37.045

	FY 2011	FY 2012
<b>Congressional Add:</b> Best Industrial Processes for Department of Defense Depots <i>FY 2011 Accomplishments:</i> Conducted Congressionally-directed effort. <i>FY 2012 Plans:</i> N/A.	8.000	-
<b>Congressional Adds Subtotals</b>	8.000	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
• N/A.: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>				<b>PROJECT</b> 635281: <i>Manufacturing Readiness</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
635281: <i>Manufacturing Readiness</i>	1.946	0.984	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

Manufacturing readiness of technologies is a key concern when identifying and mitigating risk to successfully transition these technologies and systems into production. Within each product sector (aeronautical, space, munitions/directed energy, and C2ISR), manufacturing readiness assessments (MRAs) will be applied and manufacturing readiness levels (MRLs) utilized to gauge and manage manufacturing related issues. Advanced Technology Demonstrations (ATDs) will be used when appropriate to aid in efficient transition. Selected acquisition programs will also be assessed to determine readiness for milestone decisions and/or to reduce manufacturing risk. Pervasive, generic and system-specific manufacturing maturation plans will be developed and implemented based on the assessments to reduce overall program risk and to provide an increased awareness of manufacturing issues throughout major weapon system life cycles. Generic and pervasive manufacturing issues will be identified and considered as potential ManTech programs to transition advanced manufacturing technologies into multiple sectors.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
<b>Title:</b> Major Thrust 1	1.946	0.984	-	-	-
<b>Description:</b> Through application of MRAs, develop and implement manufacturing maturation plans to improve affordability and producibility and mitigate transition risk from development to production.					
<b>FY 2011 Accomplishments:</b> Continued development of Manufacturing Maturation Plans (MMPs) for Category I ATDs and selected high-visibility programs based on MRAs. Executed selected MMPs to increase the MRL and improve technology transition to production. Conducted MRAs on selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule, or rate issues. Documented manufacturing risk based on the assessments and deliver results to the appropriate program offices. Vetted pervasive manufacturing issues discovered during the assessments through the ManTech requirements process.					
<b>FY 2012 Plans:</b> Continue development of MMPs for Category I ATDs and selected high-visibility programs based on MRAs. Conduct MRAs on selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule, or rate issues.					
<b>FY 2013 Base Plans:</b> Work completed in FY12.					
<b>FY 2013 OCO Plans:</b>					



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<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>	<b>PROJECT</b> 635281: <i>Manufacturing Readiness</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
N/A.					
<b>Accomplishments/Planned Programs Subtotals</b>	1.946	0.984	-	-	-

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A.

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	30.403	38.628	31.419	-	31.419	48.093	41.993	42.334	46.550	Continuing	Continuing
635319: <i>Anticipatory OPS Intent and Response</i>	7.553	8.738	4.870	-	4.870	6.676	6.229	5.761	5.840	Continuing	Continuing
635320: <i>Assured Worldwide Connectivity</i>	7.676	11.871	13.103	-	13.103	19.085	15.468	14.640	17.115	Continuing	Continuing
635321: <i>Global Battlespace Awareness</i>	8.764	10.494	7.869	-	7.869	14.979	13.675	15.454	15.196	Continuing	Continuing
635322: <i>Knowledge Management and Computing</i>	6.410	7.525	5.577	-	5.577	7.353	6.621	6.479	8.399	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program develops and demonstrates Air Force Enterprise-Centric Information technologies for the warfighter. The Global Battlespace Awareness project develops, integrates, and demonstrates advanced technologies to achieve comprehensive net-centric operations and total battlespace awareness by using and exploiting information from all sources. The Assured Worldwide Connectivity project provides advanced net-enabled architectures and communications technologies in support of global military operations, including a secure information grid for worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information. In addition, this project develops and demonstrates advanced optical networking and communications for Air Force air- and space-based information exchange on and between platforms. These optical networks will be rapidly deployable, mobile, interoperable, and seamless between Air and Space Operations Centers (AOC) and air- and space- based platforms either en route or in theater. This project also provides the tools and applications leading to the development and integration of cyber deterrence technologies resulting in a strategic capability of cyber dominance within the secure information grid. The Knowledge Management and Computing project develops the technology applications that will provide for a secure, tailored, seamless exchange of information among producers, consumers, and managers of information relevant to a particular community of interest (COI). The project also provides the development of interactive and real-time computing technologies that greatly improve the usability of high performance computing for the exchange, utilization, and management of information in the enterprise. The Anticipatory Ops Intent and Response project develops the technologies for dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate the battlespace. This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing upgrades and/or new system developments that have military utility and address warfighter needs.

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Air Force** **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>	<b>R-1 ITEM NOMENCLATURE</b>
3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i>	PE 0603788F: <i>Global Information Dev/Demo</i>
BA 3: <i>Advanced Technology Development (ATD)</i>	

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	32.382	38.656	43.536	-	43.536
Current President's Budget	30.403	38.628	31.419	-	31.419
Total Adjustments	-1.979	-0.028	-12.117	-	-12.117
• Congressional General Reductions	-	-0.028			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.023	-			
• SBIR/STTR Transfer	-0.758	-			
• Other Adjustments	-0.198	-	-12.117	-	-12.117

**Change Summary Explanation**

FY11: Other Adjustments include -0.198 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635319: <i>Anticipatory OPS Intent and Response</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635319: <i>Anticipatory OPS Intent and Response</i>	7.553	8.738	4.870	-	4.870	6.676	6.229	5.761	5.840	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

In order to achieve information dominance, the Air Force must be able to monitor, assess, plan, and execute (MAPE) missions rapidly across the full spectrum of operations (air, space, and cyberspace) at all levels of war (strategic, operational, and tactical) and during all phases of conflict (pre-conflict, conflict through stability operations). This project develops and integrates decision support technologies that will enhance the commander's ability to anticipate and dominate the future battlespace by more effectively forecasting the evolution of the battlespace and by more rapidly generating options to "virtually checkmate" the adversary. It develops the decision aid technologies and processes to plan the use of various assets and assess their effects in the battlespace. It provides a tailorable information environment to effectively portray complex data sets accurately in real-time.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Major Thrust 1.	0.359	1.234	-
<b>Description:</b> Develop and demonstrate distributed information technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media and multi-spectral data.			
<b>FY 2011 Accomplishments:</b> Completed development of capabilities to allow seamless information sharing for enhanced situational awareness and understanding by the decision maker. Developed an initial capability to plan and measure effectiveness of information operations synchronized with precision munitions to determine successful achievement of command intent in time and location. Conducted a campaign of experimentation to quantitatively measure transformational command and control (C2) concepts enabled by net centric warfare capabilities. Investigated space C2 planning and scheduling technologies to enable enhanced space operations. Developed an integrated C2 tasking capability to enable seamless full spectrum options to be reasoned over and recommendations provided to the operator that will meet commander's intent. Completed the development of the capability to integrate a variety of user-defined operating display technologies to visualize individual data set contexts for better situational awareness across the air, space, and cyber domains at the strategic, operational, and tactical levels. Developed and demonstrated enhanced capability to conduct space C2.			
<b>FY 2012 Plans:</b> Complete development of and demonstrate enhanced capability to conduct space C2. Complete campaign of experimentation to quantitatively measure transformational C2 concepts enabled by net centric warfare capabilities. Complete the investigation of space C2 planning and scheduling technologies to enable enhanced space operations. Complete development of an integrated			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635319: <i>Anticipatory OPS Intent and Response</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
C2 tasking capability to enable seamless full spectrum options to be reasoned over and recommendations provided to the operator that will meet commander's intent. <b>FY 2013 Plans:</b> This thrust was completed in Fy 2012.				
<b>Title:</b> Major Thrust 2. <b>Description:</b> Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive replanning and decision support tools. <b>FY 2011 Accomplishments:</b> Developed capabilities to be more agile within a net centric enabled environment. Developed timely option generation, selection, and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making processes. Developed dynamic workflow and workload management capabilities to manage the C2 enterprise. Completed development of a capability to assess adverse events that could potentially impact air and space mobility operations and suggest courses of action (COAs) that could be initiated to continue operations. Investigated methods to evaluate mobility COAs covering planning through assessment that anticipates multiple constraints and provides prioritized, feasible recommendations that meet commander's intent. Developed capability to assess the impact of cyber on air and space C2 operations and suggest COAs to be initiated to continue operations in the face of cyber threats. <b>FY 2012 Plans:</b> Complete the investigation of methods to evaluate mobility COAs covering planning through assessment that anticipates multiple constraints and provides prioritized feasible recommendations that meets commander's intent. Initiate development of net-centric mission planning and execution capabilities to support master space plan and joint space task order production and a net enabled dynamic decision support capability for a variety of air and space missions. <b>FY 2013 Plans:</b> Continue development of net-centric mission planning and execution capabilities to support a net enabled dynamic decision support capability for a variety of air and space missions in support of global operations. Initiate design and development of a set of planning tools and services that proactively build and shape the portion of cyberspace employed in support of Mission Assurance (MA) objectives.		6.046	3.345	3.265
<b>Title:</b> Major Thrust 3. <b>Description:</b> Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable decision makers to determine operational effects.		1.148	4.159	1.605

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635319: <i>Anticipatory OPS Intent and Response</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Developed and demonstrated real-time information technologies that enable a decision maker to comprehend their current situational awareness by assessing an operation's progress against desired effects (reflective) and identifying key indicators and observables to assist in anticipating future success or failure of a campaign (predictive). Completed investigating and evaluating methods to enable a decision support environment that enables the decision maker to anticipate and shape all aspects of the future battlespace. Developed predictive battlespace planning tools with the ability to reason over models of the "enemy as a system." Demonstrated a suite of interacting tools/services that assist analysts in estimating the cascading effects of proposed actions in near-real-time for diverse COAs.</p> <p><b><i>FY 2012 Plans:</i></b> Integrate and test decision support environment, within service oriented architectures, that enables the decision maker to anticipate and shape all aspects of the future battlespace. Complete development of predictive battlespace planning tools with the ability to reason over models of the "enemy as a system." Conduct simulation experiments to analyze courses of action and evaluate capabilities across multiple domains. Design and conduct limited technology experiments to investigate the technical and operational challenges associated with integrated air, space, and cyber C2 within and across multiple service oriented architectures. Continue the development and demonstration of real-time information technologies that enable a decision maker to comprehend their current situational awareness by assessing an operation's progress against desired effects (reflective) and identifying key indicators and observables to assist in anticipating future success or failure of a campaign (predictive). Initiate integration of cascading courses of action reasoners. Initiate development of a toolset for predictive assessment, developing insight into action, causal mechanisms, and their effects.</p> <p><b><i>FY 2013 Plans:</i></b> Continue an integration and test decision support environment, within service oriented architectures, that enables the decision maker to anticipate and shape all aspects of the future battlespace. Continue designing and conducting limited technology experiments to investigate the technical and operational challenges associated with integrated air, space, and cyber C2 within and across multiple service oriented architectures. Continue the development and demonstration of real-time information technologies that enable a decision maker to comprehend their current situation by assessing an operation's progress against desired effects (reflective) and identifying key indicators and observables to assist in anticipating future success or failure of a campaign (predictive).</p>			
<b>Accomplishments/Planned Programs Subtotals</b>	7.553	8.738	4.870

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force	<b>DATE:</b> February 2012
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**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force									<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>				<b>PROJECT</b> 635320: <i>Assured Worldwide Connectivity</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
635320: <i>Assured Worldwide Connectivity</i>	7.676	11.871	13.103	-	13.103	19.085	15.468	14.640	17.115	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The Air Force requires advanced net-enabled architectures and communications technologies in support of global kinetic and non-kinetic military operations including a secure information grid for worldwide information delivery and exchange of near-real-time information including voice, data, video, and imagery. This secure environment will be rapidly deployable, mobile, interoperable, and seamless between Air and Space Operations Centers (AOC) and aircraft, either en route or in theater. This project provides secure information transmission capabilities for a persistent, global, survivable communications backbone network accessible for warfighters operating in all domains; it provides self-healing, self-configuration, anti-jam communication networking capabilities; and it provides enterprise networking capabilities for agile, policy-based network management. In addition, this project develops and demonstrates advanced optical networking and communications for Air Force air- and space-based information exchange on and between platforms including development of highly integrated multi-gigabit optical and radio frequency networks, all optical data routers, optical backbone interface circuits for on board information exchange, and integrated electronic, adaptive optic systems for atmospheric mitigation. The Air Force also requires the ability to deliver sovereign options in cyberspace through the development and integration of cyber attack, cyber defense, and cyber support technologies for a strategic capability of cyber dominance. This project develops the ability to deliver cyber attack capabilities (access, stealth and persistence, cyber intelligence, and weapons delivery), cyber defense capabilities (attack detection, attack attribution, and response automation), and cyber support capability (situational awareness and war gaming.)

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b>Title:</b> Major Thrust 1.</p> <p><b>Description:</b> Develop and demonstrate secure wideband assured networking between weapon platforms, ground facilities, and Special Operations teams.</p> <p><b>FY 2011 Accomplishments:</b> Completed development of small form-factor networking and reachback capability.</p> <p><b>FY 2012 Plans:</b> Note: This effort completed in FY 2011.</p> <p><b>FY 2013 Plans:</b> N/A</p>	0.305	-	-
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Proactively defend cyberspace through cyber situational awareness, detecting, and defeating cyber threats, and surviving through adaptation and self-generation.</p>	2.835	2.502	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Developed a comprehensive situational awareness and understanding capability of cyber network assets, both red and blue forces, to include both virtual and physical cyber assets. Developed assured end-to-end quality of assurance (QoA) and QoA integration to the information system enterprise during malicious and non-malicious faults. Developed capability to automatically discover large-scale network topologies to enhance cyber situation assessment and map the discovered topologies to mission essential functions. Initiated the development of technologies that provides knowledge of the adversary to strengthen the quality of threat assessments. Completed the development of a cross-domain voice-over-IP (VOIP) capability to enhance the utility of voice transmissions within a mobile tactical environment. Developed cyber testbed capability for in-house investigations of cyber defense policies and offensive cyber techniques with the ability to conform to command intent for cyber indications and warning, and rules of engagement.</p> <p><b><i>FY 2012 Plans:</i></b> Complete development of capability to automatically discover large-scale network topologies to enhance cyber situation assessment and map the discovered topologies to mission essential functions. Complete the development of technologies that provides knowledge of the adversary to strengthen the quality of threat assessments. Develop a capability to integrate indications and warnings and observables into situation awareness and impact assessment capabilities. Complete assured end-to-end QoA and QoA integration to the information system enterprise during malicious and non-malicious faults.</p> <p><b><i>FY 2013 Plans:</i></b> Effort completes in FY 2012. Additional defensive cyber efforts are in Major Thrust 5.</p>				
<p><b><i>Title:</i></b> Major Thrust 3.</p> <p><b><i>Description:</i></b> Develop and demonstrate offensive cyber operations capabilities in a series of Experimental Cyber Craft technology demonstrations.</p> <p><b><i>FY 2011 Accomplishments:</i></b> Analyzed development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and Cyber C2 operations functions.</p> <p><b><i>FY 2012 Plans:</i></b> Conduct experiments using testbed capability for in-house investigations of cyber defense policies and offensive cyber techniques to gain a better understanding of how an adversary might attack Air Force systems. Continue to analyze development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and Cyber C2 operations functions.</p> <p><b><i>FY 2013 Plans:</i></b></p>		2.484	3.070	3.825

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Continue conducting experiments using testbed capability for in-house investigations of cyber defense policies and offensive cyber techniques to gain a better understanding of how an adversary might attack Air Force systems. Complete analysis of the development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and Cyber C2 operations functions. Continue to develop and demonstrate capabilities that provide integrated cyber operations.				
<p><b>Title:</b> Major Thrust 4.</p> <p><b>Description:</b> Develop and demonstrate intelligent networking transport and management technology to provide assured, seamless, battlespace connectivity to the Air Force.</p> <p><b>FY 2011 Accomplishments:</b> Demonstrated high capacity assured access (anti-jam) communications for global spectrum dominance. Developed quality of service (QoS)-enabled information management and dissemination combined with network policy language for efficient, prioritized information exchange in airborne networks.</p> <p><b>FY 2012 Plans:</b> Initiate development of cognitive radio technology that will enable mission specific adaptive optimization of communications links responsive to current conditions, situations, and priorities as each mission is executed. Initiate advanced demonstration of end-to-end QoS and QoA performance for various application-dependent network configuration, management, and implementation scenarios.</p> <p><b>FY 2013 Plans:</b> Complete development of cognitive radio technology that will enable mission specific adaptive optimization of communications links responsive to current conditions, situations, and priorities as each mission is executed. Continue advanced demonstration of end-to-end QoS and QoA performance for various application-dependent network configuration, management, and implementation scenarios.</p>		0.820	0.859	0.998
<p><b>Title:</b> Major Thrust 5.</p> <p><b>Description:</b> Integrate and demonstrate a resilient and self-regenerating information enterprise that dynamically recognizes, characterizes, and understands novel cyber attacks and reconfigures and self-optimizes to resist new attacks.</p> <p><b>FY 2011 Accomplishments:</b> Integrated technologies to recognize, characterize, and understand attacks and anomalies, aid in the creation of synthetically diverse, functionally equivalent software, and continuously monitor, reconfigure, and self-optimize.</p> <p><b>FY 2012 Plans:</b></p>		0.566	4.613	6.399

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Continue integration technologies to recognize, characterize, and understand attacks and anomalies, aid in the creation of synthetically diverse, functionally equivalent software, and continuously monitor, reconfigure, and self-optimize. Initiate developing techniques for guaranteeing the execution of critical processes during system recovery and data reconstitution.</p> <p><b>FY 2013 Plans:</b> Continue integration technologies to recognize, characterize, and understand attacks and anomalies, aid in the creation of synthetically diverse, functionally equivalent software, and continuously monitor, reconfigure, and self-optimize. Continue developing techniques for guaranteeing the execution of critical processes during system recovery and data reconstitution.</p>				
<p><b>Title:</b> Major Thrust 6.</p> <p><b>Description:</b> Integrate technology to demonstrate an effects-based strategic approach to cyber defense that focuses on avoiding, deferring, and minimizing the threat, and rendering the adversary ineffective.</p> <p><b>FY 2011 Accomplishments:</b> Developed technologies to simulate a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Initiated development of capability to automatically generate secure system/network configuration based on policy, architectural specifications, and operational requirements.</p> <p><b>FY 2012 Plans:</b> Continue to develop technologies to simulate a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Continue development of capability to automatically generate secure system/network configuration based on policy, architectural specifications, and operational requirements.</p> <p><b>FY 2013 Plans:</b> Continue to develop technologies to simulate a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Continue development of capability to automatically generate secure system/network configuration based on policy, architectural specifications, and operational requirements.</p>		0.666	0.572	0.188
<p><b>Title:</b> Major Thrust 7.</p> <p><b>Description:</b> Develop and demonstrate flight ready systems consisting of high capacity radio frequency (RF) and optical components and architectures for next generation communications.</p> <p><b>FY 2011 Accomplishments:</b> Note: The FY 2010 effort showed that the technology had not matured enough for an advanced technology demonstration. In FY 2011, the effort was returned to applied research for further maturation.</p> <p><b>FY 2012 Plans:</b></p>		-	0.255	1.693

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013
Develop and demonstrate a directional networking prototype for tactical data links. (This is a different effort from the one sent back to applied research for maturation.)			
<b><i>FY 2013 Plans:</i></b> Initiate development of V/W band (50 GHz to 110 GHz) airborne communications components. Initiate flight demonstration of communications systems for use in contested environments.			
<b>Accomplishments/Planned Programs Subtotals</b>	7.676	11.871	13.103

**C. Other Program Funding Summary (\$ in Millions)**

<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635321: <i>Global Battlespace Awareness</i>	8.764	10.494	7.869	-	7.869	14.979	13.675	15.454	15.196	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

In order to achieve information dominance, the Air Force must be able to monitor, assess, plan, and execute (MAPE) missions rapidly across the full spectrum of operations (air, space, and cyberspace) at all levels of war (strategic, operational, and tactical) and during all phases of conflict (pre-conflict, conflict through stability operations). This project develops, integrates, and demonstrates advanced technologies to achieve comprehensive net-centric operations and Predictive Battlespace Awareness using information from all sources. Technology development includes: tasking information collectors (intelligence, surveillance, and reconnaissance platforms, national intelligence sources, etc.); correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing information from multiple sources to create a digital-n-dimensional representation of the battlespace; assessing the situation; predicting adversary courses of action (COA); and archiving the results for ready use by decision makers. This is a dynamic, complex process that involves technologies for information exploitation, fusion, processing, storage, and retrieval, as well as technologies for machine reasoning, pattern recognition, and timeline analysis.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	2.648	2.698	1.332
<p><b>Description:</b> Demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction.</p> <p><b>FY 2011 Accomplishments:</b> Developed methodologies and processing of collecting intelligence data from a collection of ever present stand-in multi-sensor ad-hoc networks. Conducted space situational awareness (SSA) research in the development of a set of algorithms that can both automatically track space objects and complete demonstration of algorithms to detect changes in satellite images. Developed enhanced signal processing techniques to fit into existing Intelligence, Surveillance, and Reconnaissance (ISR) infrastructures. Integrated previously developed watermarking techniques and protocols for information assurance, provenance, and pedigree leading to the integration of watermarking technologies into network-centric programs of record, and initiated development of novel steganalysis methods for identifying and disrupting embedded information.</p> <p><b>FY 2012 Plans:</b> Complete development to enhance signal processing techniques to fit into existing ISR infrastructures. Complete the development of a set of algorithms that can automatically track space objects in support of SSA. Continue both the integration of developed watermarking techniques and protocols for information assurance, provenance, and pedigree leading to the integration</p>			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
of watermarking technologies into network-centric programs of record, and the development of novel steganalysis methods for identifying and disrupting embedded information. <b>FY 2013 Plans:</b> Continue both the integration of developed watermarking techniques and protocols for information assurance, provenance, and pedigree leading to the integration of watermarking technologies into network-centric programs of record, and the development of novel steganalysis methods for identifying and disrupting embedded information.				
<b>Title:</b> Major Thrust 2. <b>Description:</b> Developed and demonstrated advanced data handling, event visualization technologies, and distributed data fusion to enable a more effective utilization of data available. <b>FY 2011 Accomplishments:</b> Developed mature and integrated models for adversarial behavior and provide support for situation analysis utilizing a service oriented architecture. Developed and demonstrated the capability to conduct distributed fusion to enhance situational awareness of the battlespace. Initiated development of algorithmic tools and techniques to analyze and exploit recorded signals intelligence data across multiple missions, to provide the capability for forensic analysis of single or multi-platform data across multiple missions for increased situational awareness and intelligence. <b>FY 2012 Plans:</b> Continue development to mature and integrate models for adversarial behavior and provide support for situation analysis utilizing a service oriented architecture. Continue development of algorithmic tools and techniques to analyze and exploit recorded signals intelligence data across multiple missions, to provide the capability for forensic analysis of single or multi-platform data across multiple missions for increased situational awareness and intelligence. <b>FY 2013 Plans:</b> Complete development to mature and integrate models for adversarial behavior and provide support for situation analysis utilizing a service oriented architecture. Complete development of algorithmic tools and techniques to analyze and exploit recorded signals intelligence data across multiple missions, to provide the capability for forensic analysis of single or multi-platform data across multiple missions for increased situational awareness and intelligence. Initiate development of a prototype for the fusion of information (temporally and geospatially) from multiple exploitation domains to create a comprehensive understanding of the battlespace.		2.730	3.949	1.743
<b>Title:</b> Major Thrust 3. <b>Description:</b> Develop and demonstrate capabilities for reasoning and learning, text understanding, link and group discovery, and advanced analysis for situational awareness and understanding.		0.257	0.471	0.879

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Developed a text extraction capability that enables users to fine-tune the extractor, based on their specialized knowledge of the domain, to achieve higher performance. Developed tools and services for advanced behavioral modeling techniques and advanced capabilities for analysis that integrate situation understanding, situation monitoring, and event anticipation. Initiated development of dynamic social network analysis methods to provide the analyst with the ability to identify high value targets in social networks and anticipate their role and activity. Developed a set of algorithms that can automatically develop, reason, dynamically update various sub-sets of the existing intelligence preparation of the battlespace products, and initiated development of techniques for analyzing and assessing activities to support situation assessment.</p> <p><b><i>FY 2012 Plans:</i></b> Complete development of a text extraction capability that enables users to fine-tune the extractor, based on their specialized knowledge of the domain, to achieve higher performance. Complete development of tools and services for advanced behavioral modeling techniques and advanced capabilities for analysis that integrate situation understanding, situation monitoring, and event anticipation. Initiate exploring general purpose bridges between the corpus of electronic text and formal reasoning systems. Continue development of dynamic social network analysis methods to provide the analyst with the ability to identify high value targets in social networks and anticipate their role and activity. Complete development of a set of algorithms that can automatically develop, reason, dynamically update various sub-sets of the existing intelligence preparation of the battlespace products, and continue development of techniques for analyzing and assessing activities to support situation assessment.</p> <p><b><i>FY 2013 Plans:</i></b> Continue exploring general purpose bridges between the corpus of electronic text and formal reasoning systems. Complete development of dynamic social network analysis methods to provide the analyst with the ability to identify high value targets in social networks and anticipate their role and activity.</p>				
<p><b><i>Title:</i></b> Major Thrust 4.</p> <p><b><i>Description:</i></b> Develop models to provide detailed understanding of the adversary's probable intent and future strategy to identify adversary COAs, the most likely COA, and the COA most dangerous to friendly forces and mission accomplishment.</p> <p><b><i>FY 2011 Accomplishments:</i></b> Completed research to forecast actionable futures to support a decision maker's ability to appraise and plan the "best" blue course of action for rapid decide, act, and adapt (RDAA). Completed investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). Investigated the capability to manage multiple possible future adversary COAs prioritized based on current and future (projected) impact/threat. Investigated screening techniques that give the analyst/decision maker insight into the contribution or sensitivity of various factors on a given observable/response, initiated investigation of techniques that will allow model adaptation to new regions and nations, and started</p>		3.129	3.376	3.915



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013
development of a functional graphical user environment to support output analysis. Initiated capability to model and explore policy actions and reactions taken by the different modeled entities. Initiated development and demonstrate of robust support applications to enhance multi-intelligence collection requirements.			
<b><i>FY 2012 Plans:</i></b> Continue development of a functional graphical user environment to support output analysis and complete investigations in developing screening techniques that give the analyst/decision maker insight into the contribution or sensitivity of various factors on a given observable/response and use scenarios and conduct user testing and feedback of models for new regions and nations. Complete investigation of the capability to manage multiple possible future adversary COAs prioritized based on current and future (projected) impact/threat. Continue developing capability to model and explore policy actions and reactions taken by the different modeled entities, and start developing the capability to allow users to perform automated generation, assessment, and visualization of traces from model results to key underlying causes. Continue to develop and demonstrate robust support applications to enhance multi-intelligence collection requirements.			
<b><i>FY 2013 Plans:</i></b> Continue development of a functional graphical user environment to support output analysis and complete investigations in developing screening techniques that give the analyst/decision maker insight into the contribution or sensitivity of various factors on a given observable/response and use scenarios and conduct user testing and feedback of models for new regions and nations. Continue developing capability to model and explore policy actions and reactions taken by the different modeled entities, and start developing the capability to allow users to perform automated generation, assessment, and visualization of traces from model results to key underlying causes. Initiate development of tools to increase awareness of alternatives and ramifications of selecting given target sets. Initiate development of exploitation and analysis tools to automate target recognition and tracking.			
<b>Accomplishments/Planned Programs Subtotals</b>	8.764	10.494	7.869

<b>C. Other Program Funding Summary (\$ in Millions)</b>							<b>Cost To</b>					
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Complete</u>	<u>Total Cost</u>	
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635322: <i>Knowledge Management and Computing</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
635322: <i>Knowledge Management and Computing</i>	6.410	7.525	5.577	-	5.577	7.353	6.621	6.479	8.399	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The Air Force requires technologies that will provide the decision maker and staff with seamless access to tailored information within a mobile, dynamic, and scalable, globally distributed Air and Space Operations Center (AOC), as well as among other producers, consumers, and managers of information relevant to other particular communities of interest (COI). This project demonstrates the enterprise management capabilities needed for the rapid distribution of actionable information, as well as the needed advances in high performance computing to ensure this complex capability. This project develops an agile information environment that focuses on quality of service, transformation and brokering, a federated information environment focusing the relationship among the members of the environment, a secure cross-domain information sharing capability that focuses on the security layer and inter-COI information exchange in different security domains, and a collaboration environment focusing on the information workflow layer of the enterprise. This project will also develop: 1) a computational science and engineering capability demonstrating new models of computation; 2) novel approaches for high performance, interactive, net-centric, distributed, and embedded computing systems; and 3) the technological tools enabling affordable, large-scale, complex, software intensive systems.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Major Thrust 1.	2.619	1.201	0.559
<b>Description:</b> Develop and demonstrate computer architectures with greater capacity and sophistication to enable game changing computing power to the warfighter, anywhere, anytime.			
<b>FY 2011 Accomplishments:</b> Developed petaflops embedded on-demand computing and completed demonstration of real-time high performance computing services to enhance space situational awareness and complete enhancement of firmware and software for existing high performance computer boards for plug-and play-satellite. Completed development and demonstration of stacked chip architecture for cognitive and autonomous systems. Developed and demonstrated high-payoff, high performance computing applications to reduce size, weight, and power restrictions. Completed development of predictable software testing tools to ease the complexity, understanding, and managing software in software-intensive systems. Initiated development of comprehensive software and hardware solutions for parallel discrete event simulation on emerging multi-core architectures. Completed development and prototype demonstration of trusted router hardware based upon a hardware root of trust.			
<b>FY 2012 Plans:</b> Continue the development of petaflops embedded on-demand computing, and demonstrate achieved performance and functionality. Initiate development of architectures for a compact large array of many node clusters with very low power demand for intelligent systems. Initiate development and demonstration of an autocode generation capability for software intensive			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635322: <i>Knowledge Management and Computing</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>systems. Complete development of comprehensive software and hardware solutions for parallel discrete event simulation on emerging multi-core architectures.</p> <p><b>FY 2013 Plans:</b> Complete the development of petaflops embedded on-demand computing, and demonstrate achieved performance and functionality. Continue development of architectures for a compact large array of many node clusters with very low power demand for intelligent systems. Continue development and demonstration of an autocode generation capability for software intensive systems.</p>				
<p><b>Title:</b> Major Thrust 2.</p> <p><b>Description:</b> Demonstrate how a publish, subscribe, and query information management paradigm can enable vertical and horizontal integration of Air Force information systems.</p> <p><b>FY 2011 Accomplishments:</b> Developed secure, accreditable cross domain information sharing techniques in an operational setting and developed a scalable integrated environment where information is easily and securely shared across multiple secure domains while preventing accidental or intentional information disclosure. Developed an adaptive security policy expression and enforcement mechanism for automated information review and release among different security domains. Completed development of a method to securely link data and metadata.</p> <p><b>FY 2012 Plans:</b> Complete development of an adaptive security policy expression and enforcement mechanism for automated information review and release among different security domains. Complete developments of secure, accreditable cross domain information sharing techniques in an operational setting and of a scalable integrated environment where information is easily and securely shared across multiple secure domains while preventing accidental or intentional information disclosure. Initiate development of attack resistant cross domain services.</p> <p><b>FY 2013 Plans:</b> Continue development of attack resistant cross domain services.</p>		1.036	0.534	0.721
<p><b>Title:</b> Major Thrust 3.</p> <p><b>Description:</b> Demonstrate how agile information management services enable effective information sharing in a tactical environment.</p> <p><b>FY 2011 Accomplishments:</b></p>		2.755	5.790	4.297

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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635322: <i>Knowledge Management and Computing</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>Developed tactical information management(IM) pub/sub/query mechanisms focusing on stability, performance, and reliability for assured access and isolation from malicious client applications, and assured levels of QoS. Initiated investigating and quantifying the network burden and quality of service requirements for service oriented architecture implementations across a variety of tactical environments. Initiated development of survivable IM services that are highly adaptive and self-aware across the variety of IM architectures.</p> <p><b>FY 2012 Plans:</b> Continue development of tactical information management pub/sub/query mechanisms focusing on stability, performance, and reliability for assured access and isolation from malicious client applications, and assured levels of QoS. Initiate design and development of a mission oriented, highly adaptive and self-aware unified intelligent capability to provide observable, actionable insights and visibility across information management services and their deployed platforms from inside-out and provide survivability-aware information sharing capabilities to anticipate achieving the information level mission goals under any conditions. Continue investigating and quantifying the network burden and quality of service requirements for service oriented architecture implementations across a variety of tactical environments. Continue development of survivable IM services that are highly adaptive and self-aware across the variety of IM architectures.</p> <p><b>FY 2013 Plans:</b> Complete development of tactical information management pub/sub/query mechanisms focusing on stability, performance, and reliability for assured access and isolation from malicious client applications, and assured levels of QoS. Continue design and development of a mission oriented, highly adaptive and self-aware unified intelligent capability to provide observable, actionable insights and visibility across information management services and their deployed platforms from inside-out and provide survivability-aware information sharing capabilities to anticipate achieving the information level mission goals under any conditions. Continue investigating and quantifying the network burden and quality of service requirements for service oriented architecture implementations across a variety of tactical environments. Continue to develop information management capabilities in support of force protection.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>	6.410	7.525	5.577

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u> <u>Base</u>	<u>FY 2013</u> <u>OCO</u>	<u>FY 2013</u> <u>Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Air Force		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>	<b>PROJECT</b> 635322: <i>Knowledge Management and Computing</i>

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603924F: <i>High Energy Laser Advanced Technology Program</i>
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COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	1.779	1.122	-	-	-	-	-	-	-	Continuing	Continuing
635095: <i>High Energy Laser Advanced Technology Program</i>	1.779	1.122	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program funds Department of Defense (DoD) high energy laser (HEL) advanced technology development through the HEL Joint Technology Office (JTO). HEL weapons have many potential advantages including speed-of-light delivery, precision target engagement, significant magazine depth, low-cost per kill, and reduced logistics requirements. HEL weapons have the potential to perform a wide variety of military missions including defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles and the ultra-precision negation of targets in urban environments with minimal collateral damage. This program is part of the overall DoD HEL Science and Technology program. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates HEL capabilities and concepts.

**B. Program Change Summary (\$ in Millions)**

	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>
Previous President's Budget	1.847	1.122	1.237	-	1.237
Current President's Budget	1.779	1.122	-	-	-
Total Adjustments	-0.068	-	-1.237	-	-1.237
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.054	-			
• Other Adjustments	-0.014	-	-1.237	-	-1.237

**Change Summary Explanation**

FY11: Other Adjustments include -0.014 Congressional General Reductions

Decrease in FY13 is due to higher Department of Defense priorities.

**C. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<b>Title:</b> Major Thrust 1.	1.779	1.122	-	-	-

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Air Force **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603924F: <i>High Energy Laser Advanced Technology Program</i>
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
<p><b>Description:</b> Advance solid state laser development. Develop beam-control technologies for surface and air mission areas.</p> <p><b>FY 2011 Accomplishments:</b> Initiated integration of a joint high-power beam director, with a 100 kilowatt-class laser device, in preparation for system tests in a field environment at High Energy Laser Systems Test Facility (HELSTF).</p> <p><b>FY 2012 Plans:</b> Complete integrated systems field tests at HELSTF. Demonstrate solid-state laser capability with adaptive optics beam control architecture in a field environment against selected targets.</p> <p><b>FY 2013 Base Plans:</b> Reduction due to higher Department of Defense priorities.</p> <p><b>FY 2013 OCO Plans:</b> N/A</p>					
<b>Accomplishments/Planned Programs Subtotals</b>	1.779	1.122	-	-	-

<b>D. Other Program Funding Summary (\$ in Millions)</b>										
<u>Line Item</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013 Base</u>	<u>FY 2013 OCO</u>	<u>FY 2013 Total</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>Cost To Complete Total Cost</u>
• N/A: N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000 Continuing Continuing

**E. Acquisition Strategy**  
N/A

**F. Performance Metrics**  
Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.